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An investigation of social carrying capacity at three open space preserves

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AN INVESTIGATION OF SOCIAL CARRYING CAPACITY AT THREE OPEN SPACE PRESERVES

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ABSTRACT

AN INVESTIGATION OF SOCIAL CARRYING CAPACITY
AT THREE OPEN SPACE PRESERVES

by Carol L. Borck

This study investigates and determines the social carrying capacities of three open space preserves managed by Midpeninsula Regional Open Space District located in the central San Francisco Peninsula. Close proximity to large San Francisco Bay Area communities and multi-use recreational opportunities have resulted in escalating visitation levels at many preserves. When recreationists encounter increasingly more groups of people within an area, perceptions of crowding intensify and experience quality can deteriorate.

Questionnaires distributed to recreationists at each preserve collected data used in three semi-quantitative approaches to determining social capacity. Additionally, recreationists' psychological coping behaviors were analyzed to explain possible differences between the estimated capacities.

The results indicate that the preserves are generally experiencing encounter levels below social carrying capacities. Evidence of displacement coping behaviors by recreationists was found to partially explain the differences in social capacities between the three preserves.

ACKNOWLEDGMENTS

I would like to thank Midpeninsula Regional Open Space District for their helpfulness, donation of materials, and brightening up of some of the most difficult days of my life. And, thank you, Neva, for your undying support and patience these last five years.

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CHAPTER I

INTRODUCTION

Open Space: Definition and Uses

The San Francisco Bay Region is an area of unsurpassed natural beauty. Oak-dotted hillsides, lushly vegetated mountain ranges, and life-abundant tidal wetlands encompass its lively and growing cities. These environs are essential to Bay Area residents; they help to ease our feelings of crowding, provide aesthetic backdrops to our communities, and allow us to experience nature and invigorate our souls by escaping the commonplace.

As urban and suburban expansion of the San Francisco Bay Area continues, portions of our surrounding golden hillsides, remnant tidal wetlands, and wooded mountain slopes are being secured, not for development, but for preservation. Many of these protected areas are designated as open space lands. The term "open space" holds numerous definitions varying from functional to legal in nature. Open space may be land that is inappropriate for development, such as flood plains or geologically unstable zones. It may be land set aside for percolation, agriculture, or mineral extraction. Or open space can consist of lands preserved for human recreational enjoyment, plant and wildlife habitat protection, or the coexistence of both. Simply stated, open space is an area of land or water "that either remains in its natural state or is used for agriculture or otherwise essentially undeveloped" (Midpeninsula Regional Open Space District 1980, introduction). Open space lands

involved in this study consist of preserves managed for both the protection of natural habitat and promotion of public access to these natural areas for low-intensity recreation.

Although open space lands serve many practical and aesthetic functions and are a necessary component of all sustainable communities, of particular concern to this study is the quality of the variety of benefits to the human spirit that come from visiting an open space preserve. Many people escape the everyday crowds and pressures of urban living by recreating in their local open space preserves. Hiking or bicycling along peaceful hillsides or oak woodlands allows us to feel close to nature and relax in an essentially unmodified environment. The solitude offered in open space preserves rejuvenates the spirit and provides an opportunity for reflection on personal values. Experiencing the beauty of our natural surroundings, breathing cleaner air, and escaping routine contribute to our peace of mind and spiritual healing. Unfortunately, the quality of these experiences can deteriorate as open space use levels rise and recreationists begin to encounter greater numbers of other users.

Midpeninsula Regional Open Space District

The open space preserves involved in this study are located within the Midpeninsula Regional Open Space District (Figure 1). This District is a public agency formed by voter initiative in 1972. The District was initially located in northwestern Santa Clara County, however in 1976, voters expanded the District's boundaries to include southern San Mateo County. In 1992, a small portion of Santa Cruz County was annexed by the District, making it the only tri-county park or open space district in California

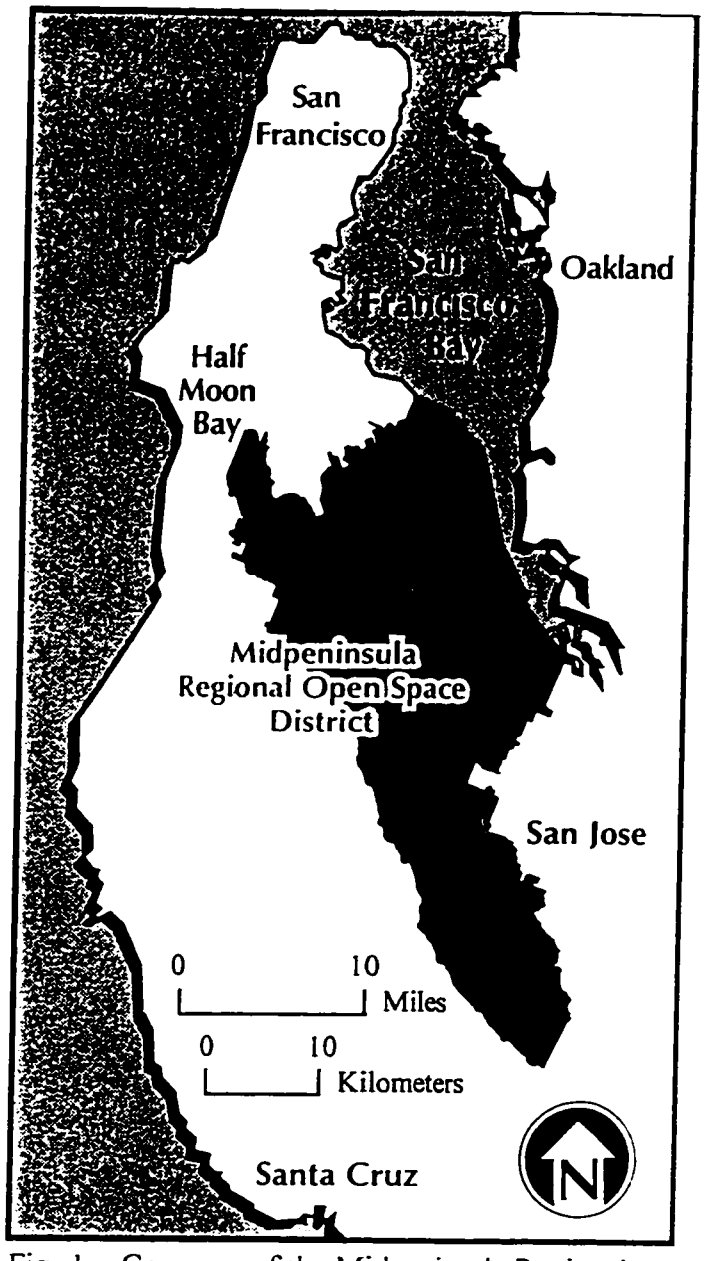

Fig. 1. Coverage of the Midpeninsula Regional Open Space District in the San Francisco Bay Region.

Source: Midpeninsula Regional Open Space District. 1995.

(Midpeninsula Regional Open Space District, 1996a).

The District's mission is to secure and "permanently protect a regional open space greenbelt, preserving the unspoiled wilderness, wildlife habitat, watershed, viewshed, and fragile ecosystems" (Midpeninsula Regional Open Space District 1996a, Welcome to Regional Open Space). Funding for the District and acquisition of open space lands is generated primarily by a share of the total annual property tax collected within the District; approximately 1.7¢ per $100 of assessed property value, or about $10 million in annual revenue (1996-1997 fiscal year). Federal and state grants, interest and rental income, donations, and note issues provide additional revenue for the District (Midpeninsula Regional Open Space District 1996a).

Currently, the District manages 23 preserves that are open daily to the public, free of charge, from dawn until one half-hour after sunset. In general, District lands are managed in their natural condition with minimal amenities required to provide public access and low-intensity recreation such as signed trails for hiking, bicycling, and equestrian use. The District's few "improved" preserves may also include parking lots, restrooms, and an occasional picnic table. Diverse ecosystems are protected and restored within the preserves including redwood, fir, and oak forests, chaparral hillsides, riparian corridors, grasslands, and San Francisco Bay wetlands. Visitors may explore any of the over 200 miles of trails located within the preserves on their own or take advantage of the many docent-led hikes which introduce visitors to the natural history, e.g., botany, geology, etc., of a particular preserve (Midpeninsula Regional Open Space District 1996a).

Importance

Although visiting an open space preserve is a healthy and exhilarating escape from common city life, the quality of open space experiences can be negatively affected when visitors encounter increasingly higher numbers of other users within a preserve. Rising use levels in open space preserves and more frequent encounters (social impact) with other visitors contribute to perceptions of crowding which can cause a deterioration in recreational experience quality. When encounters exceed an acceptable level, social carrying capacity is surpassed and management action may be necessary to restore the desired recreational experience and level of social impact. Currently, some San Francisco Bay area open space preserves are experiencing rising use levels. It is imperative that the social carrying capacity of these preserves be studied now in order to maintain the quality of visitor experiences in the future.

Social carrying capacity is defined by Shelby and Heberlein (1986, 21) as "the level of use beyond which social impacts exceed acceptable levels specified by evaluative standards." These evaluative standards are value judgments formed by recreationists that identify the tolerable (capacity) and optimum (preferred) level of social impacts. To determine social carrying capacity, there are three primary approaches to establishing evaluative standards: the "contact preference standard," the "visitor satisfaction" approach, and the "perceived crowding approach."

The "contact preference standard" determines what recreationists feel is the maximum tolerable number of encounters during activity participation. When actual contacts exceed tolerance level, social capacity is exceeded. Investigating visitor satisfaction utilizes the

"satisfaction model" which hypothesizes that satisfaction decreases as use levels or encounter levels increase, and decreasing satisfaction indicates that social capacity is being neared (Shelby and Heberlein 1986). Perceived crowding intensifies as the number of encounters exceeds a person's expected and/or preferred number of contacts. The greater the percentage of people who report some degree of perceived crowding, the closer a site is to reaching capacity (Shelby and Heberlein 1986).

When utilizing only one approach to determine social carrying capacity, Shelby and Heberlein (1984, 1986) prefer the "contact preference standard" because it specifically addresses impacts in terms of encounters with other users. Perceived crowding is judged a somewhat useful method, specifically for determining when capacity is being exceeded; and the "satisfaction approach" is the least effective because it is too general and does not take into account the variety of reasons, other than encounter levels, that can contribute to recreational dissatisfaction.

Because too many visitor encounters can diminish the quality of a recreational experience, many users avoid or adjust to these excessive contacts by means of physical or psychological coping behaviors (Hammitt and Patterson 1991). Physical avoidance includes purposely using difficult or unmaintained trails to reduce contacts or planning trips around peak use seasons. Psychological coping can be difficult to identify, however several studies have found supporting evidence of "product shift" (Manning and Ciali 1980, Shelby and Heberlein 1986, Shelby et al. 1988) and "displacement" (Becker 1981, Shelby and Heberlein 1986, Shelby et al. 1988, Kuentzel and Heberlein 1992) behaviors exhibited by recreationists attempting to maintain their satisfaction when encountering

high use and contact levels. "Product shift" occurs when users alter their perceptions of what a particular recreational setting is supposed to offer before becoming dissatisfied (Shelby and Heberlein 1986, Shelby et al. 1988). "Displacement" happens when a density sensitive user moves on to a lesser used area and is then replaced by someone who is not as sensitive to higher use levels (Shelby et al. 1988).

While many government owned public lands, such as national and state parks, often have the staff and funding available to study and monitor visitation and social impacts, most open space management organizations such as non-profit organizations and special districts like Midpeninsula Regional Open Space District operate with very limited budgets and rely on volunteerism for auxiliary projects. Many open space preserves, including Midpeninsula's, do not have regularly monitored use levels and/or research as to their social carrying capacities.

Local open space recreation is becoming increasingly popular as preserves are located relatively close to largely populated communities and they offer multi-use (hiking, biking, and equestrian) trails, some even permitting dogs. At a time when recreationists are looking for areas closer to home for a one-day, or even one-hour escape, many preserves are experiencing high volumes of unmonitored visitation. These rising use levels can lead to increases in encounters amongst recreationists, contributing to perceived crowding, visitor and use conflicts, and deterioration of visitor experience quality (Shelby and Heberlein 1986). Some recreationists may already be utilizing physical and/or psychological coping behaviors at the more frequently visited preserves to maintain satisfying experiences. For these reasons, it is critical to research and understand open

space use levels and user characteristics now, so that open space managers will have the information necessary to apply appropriate management techniques in their efforts to sustain quality visitor experiences if use levels continue to climb.

This study takes the first step in analyzing local open space social carrying capacities and provides the Midpeninsula Regional Open Space District with valuable information concerning the social state of the three preserves, as well as a general idea of the conditions being experienced at their remaining 20 preserves. This knowledge can be incorporated into the District's management framework in order to maintain visitor experience quality and initiate appropriate actions when necessary in areas where capacity may be neared. Other organizations managing open space preserves will find the results of this study beneficial when developing strategies for researching social capacity at their preserves. Data gathered will provide them with valuable insight into the social dynamics possibly existing within their preserves, and hence assist managers in choosing relevant study variables.

This study applies a more comprehensive approach to social carrying capacity determination than has been executed in past research. Previous studies (Shelby and Heberlein 1986, Shelby et al. 1989) have often employed the use of only one method to determine evaluative standards for identifying social carrying capacity. Shelby and Heberlein (1986) supported the contact preference standard as their preferred approach because it directly addresses recreationists' feelings about social impact. However, satisfaction and perceived crowding data collected during their studies could also have been integrated into their analyses for capacity determination. Social capacity need not be

based on the results of one approach. This study utilizes the results of all three approaches to produce a richer, more comprehensive measure of social capacity.

Ultimately, the results of this study will contribute to the maintenance of quality recreational experiences for users of open space preserves. Managers will gain a better understanding of visitor characteristics which will allow them to explore and implement management techniques to provide desired recreational and social conditions at their individual preserves. Open space users will enjoy escaping to preserves that meet their recreational and social preferences without feeling that their satisfaction is compromised by the effects of rising use levels.

Generality

Accelerating recreational use of public lands in the 1950's and 1960's sparked the first concerns over appropriate use levels and impacts to the quality of recreational experiences (Manning 1986). In the mid-1960's, the USDA Forest Service launched what would become a significant effort to study the effects of varying use levels on recreational experience quality. From these early studies, the concept of social carrying capacity was formulated and numerous projects were initiated to determine and analyze the social carrying capacities of various recreational settings across the United States (Shelby and Heberlein 1986).

Staggering increases in use levels of wilderness, national parks, and other public lands have occurred since the end of World War II when incomes began rising and leisure time and family camping vacations became facets of the American lifestyle. Between

WWII and 1975, national forest visitation grew an average of 10 percent each year (Stankey et al. 1976). In 1948, 6 rafters experienced the thrill of running the Colorado River through the Grand Canyon, while in 1968, 3,609 rafters, and in 1988, 22,088 rafters enjoyed the trip (Hendee et al. 1990). National Park Service figures indicate that systemwide visitation increased 30 percent during the 1970's followed by another 35 percent increase in the 1980's. Today, some 275 million people visit the national parks annually, and it is estimated that another 60 to 90 million visitors will be added to this figure by the turn of the century (Wilkinson 1995).

These great increases in public land use have created not only ecological impacts, but impacts to social conditions as well. When recreationists encounter increasingly more people within an area, perceptions of crowding intensify and experience quality can be negatively affected (Manning 1986). Visitors seeking solitude, spiritual renewal, and escape from everyday crowds find fewer opportunities to experience these freedoms when rising use levels lead to more frequent encounters. To maintain their recreational satisfaction, density sensitive users often employ physical and/or psychological coping behaviors. Unfortunately, once these coping mechanisms are no longer satisfactory to the density sensitive user, such an individual may actually feel compelled to relocate to a lesser used area (Shelby et al. 1988). However, there is a finite number of these lesser used areas and if left unchecked, rising visitor use to recreational lands could effectively nullify low-use recreation opportunities. For these reasons, it is crucial that social carrying capacities of all recreational lands be investigated and subsequently monitored so that appropriate management techniques for preserving quality visitor experiences can be

developed and implemented based on the individual needs of each recreation area and its users.

This investigation of social carrying capacity at three San Francisco area open space preserves is transferable to other open space preserves locally, nationally, and internationally. The concepts and methodology used to determine social capacity and examine the characteristics of preserve users in this study can be utilized in the research of social capacity at any open space preserve. Additionally, these techniques could be useful when determining social capacities of other types of public recreation lands as they were derived (and enhanced) from previous research of capacities of wildland and undeveloped recreational settings (Shelby and Heberlein 1986).

Objectives of the Study

The purpose of this study is to investigate and determine the social carrying capacities of Los Trancos, Monte Bello, and Rancho San Antonio Open Space Preserves in the Midpeninsula Regional Open Space District (Figure 2). In this study, social carrying capacity is defined as the point where the maximum tolerable level of social impact (encounters with other visitors) is reached and additional encounters contribute to a deterioration of users' recreational experience enjoyment. Social capacities of recreational lands generally vary based on activity type, user characteristics, and utilization of psychological coping behaviors, such as product shift and displacement. The existence of psychological coping behavior use by preserve visitors is included in this investigation.

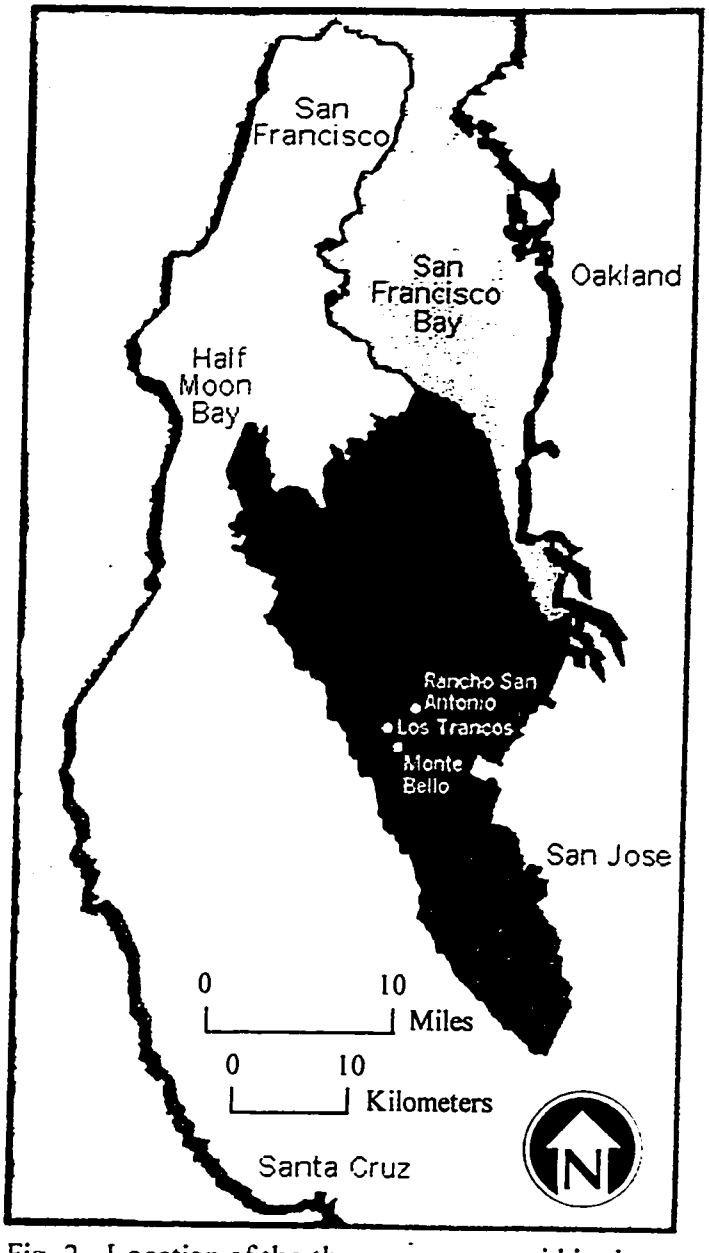

Fig. 2. Location of the three preserves within the Midpeninsula Regional Open Space District.

Source: Midpeninsula Regional Open Space District. 1995.

Specifically, the objectives of this thesis are as follows:

1. Estimate the social carrying capacities of each of the three preserves utilizing a comprehensive approach which considers the combined results of all three approaches used to estimate social carrying capacity (contact preference standard, visitor satisfaction, and perceived crowding).
2. Determine if social carrying capacity is being exceeded in the preserves.
3. Analyze differences in social capacity between the preserves by investigating the presence of psychological coping behaviors among users.

Social carrying capacity is determined not only for overall use, but also independently for different days of the week. Because the study surveys users on known low, medium, and high use days, it presents an opportunity to investigate social capacity at varying use levels. Therefore, social capacities of Tuesdays, Fridays, and Sundays are identified as well as the overall measure of social capacity which uses aggregate data from all days.

In terms of units, social carrying capacity is often expressed as the maximum tolerable number of encounters for a recreationist per day or visit or as a tolerable daily use level. However, this study measures social capacity in terms of the maximum tolerable number of encounters a preserve user experiences per visit-hour. Indicating social capacity as a level of use (e.g. users/day or the number of users at a given instant) can be helpful for managers implementing use controls, but it does not tell us about the level of impact (encounters) tolerable to the visitors. Describing social capacity as the maximum tolerable number of encounters per visit is applicable when all visitors are in the

recreational area for the same period of time. However, in the case of open space use, especially near urban areas, visit lengths may differ dramatically among users. This variability in visitation time demands a greater precision of social capacity measurement, and therefore it is most appropriate to represent capacity as the number of encounters per visit-hour.

CHAPTER II

RELATED RESEARCH

Social carrying capacity research has predominantly focused on wilderness and undeveloped recreational settings involving such user groups as rafters, boaters, backpackers, and anglers. Although no studies of social capacities at open space preserves were found, the basic concepts and methodology for investigating and determining social carrying capacities as discussed in the literature can be applied to other recreational settings (Shelby and Heberlein 1986).

Social Carrying Capacity Theory

Wager (1964) defined carrying capacity as the use level an area can support while sustaining the quality of recreation. Graefe et al. (1984) make the important observation that this early definition recognized not only an environmental element, but also a social element. Evolution of carrying capacity research has since separated the social element into a category of study unto itself. A definition of social carrying capacity is stated by Shelby and Heberlein (1986, 21) as "the level of use beyond which social impacts exceed acceptable levels specified by evaluative standards." Conceptually, social carrying capacity is about human tolerance levels and sensitivity to others (Pigram 1983). Ultimately, social carrying capacity is a management tool which can be implemented to maintain or restore the appropriate and acceptable social conditions of a specific area

based on management objectives (Stankey and McCool 1984).

According to Shelby and Heberlein (1984, 1986), knowledge of a relationship between both descriptive and evaluative components is required to establish social carrying capacity. The descriptive component consists of management parameters, such as use levels; impact parameters, such as the number of parties encountered on a backcountry hike; and the relationship between the two. The evaluative component involves value judgments regarding the type of experience to be provided and the acceptable level of impacts for that experience. This component results in setting evaluative standards that determine the tolerable and optimum level of impacts, and hence tell us how much is too much (Shelby and Heberlein 1986).

Graefe et al. (1984) similarly assert that social carrying capacity determination requires examination of the relationship between recreational use levels and human perceptions of what constitutes quality within a recreational experience. However, there are numerous psychological variables involved which contribute to how people evaluate a recreational experience. A key to understanding these variables is to first understand recreational participation and motivation (Graefe et al. 1984). People choose to participate in recreational activities not for one, but for a variety of reasons ranging from a need for solitude to being close to nature to exercise. These desires, or needs, may be ranked in order of importance by the recreationist. If one or even more of these needs or goals is not met by the recreational experience, it is still possible that the participant will be satisfied with his or her overall outdoor experience. Recreational motivations are dependent on the attitudes, expectations, and preferences of the participants (Manning

1986).

Expectations and preferences are important factors in social carrying capacity theory. Expectancy is the anticipation that a certain event or outcome will occur, while preferences are representative of what would be the desirable or ideal condition (Shelby et al. 1983). On a general level, recreational experience expectations include psychological benefits such as stress release, challenge, adventure, or autonomy (Merigliano 1989). More specifically, people have particular expectations relating to their experience such as the number of other visitors they may encounter on their hike or the type of wildlife they will see. An individual's specific expectations influence how they perceive and evaluate the quality and satisfaction of a recreation experience (Graefe et al. 1984). In general, people use their realistic expectations as evaluative standards instead of their preferences. For example, a recreationist seeking some level of solitude will feel crowded when the number of encounters exceeds their expectations, but not necessarily when their preferred number of encounters is exceeded (Shelby et al. 1983).

Determining Evaluative Standards

Establishing evaluative standards for acceptable impact levels in carrying capacity determination can be achieved by measuring individual user preferences for that particular experience. When these user preferences collectively illustrate some agreement, a shared social norm is developed. Identifying social carrying capacity requires some consensus regarding the appropriate number of encounters for that specific recreational experience. This "contact preference standard" is one example of a social norm that establishes what

people feel is the right amount of encounters (Shelby and Heberlein 1986).

In addition to the contact preference standard approach to establishing evaluative standards for capacity determination, there are two other criteria that have been used. The first, a visitor satisfaction approach, presumes that as use levels or encounter levels increase, satisfaction levels decrease, and declining satisfaction must indicate that carrying capacity has been reached (Shelby and Heberlein 1984). This inverse relationship between density and satisfaction has been coined "the satisfaction model" by Heberlein and Shelby (1977) (Manning and Ciali 1980). However, after numerous studies, researchers have found little evidence supporting this use level-based theory. It is also understood that solitude, or any other single expectation, is not the sole factor affecting visitor satisfaction. As mentioned previously, recreationists have many experience expectations that contribute to the overall quality and satisfaction of their experience (Shelby and Heberlein 1986). Although the satisfaction approach, when used as a primary method of determining social carrying capacity, has been proven ineffective, this study will include an investigation of user satisfaction. This will enhance data collected on perceived crowding, use and encounter levels, and provide greater understanding of the relationships between these variables.

Manning and Ciali (1980) discuss several hypotheses, which are also called psychological coping behaviors, that may explain why use levels and contacts often do not affect satisfaction. The "no expectations" hypothesis was developed on the idea that those recreationists with little or no experience have not formulated expectations regarding appropriate density levels, and will thus be satisfied with the setting at hand. The "product

shift" hypothesis suggests that as use levels increase, people may change their perceptions about what the recreation experience should offer in order to cope with increasing encounter levels. As a result, even as encounter levels rise, visitor satisfaction remains the same. The "displacement" hypothesis suggests that those individuals desiring lower density experiences become dissatisfied with increasing use and encounter levels and move on to lesser used areas. They are then replaced by users who are less sensitive to higher densities. The "product shift" and "displacement" hypotheses might also explain possible variations in social carrying capacity between the three open space preserves in this study. In addition to these three hypotheses, Shelby et al. (1988) assert that recreation is self-selected and voluntary, so people generally choose activities which will be satisfying, and hence high satisfaction is reported regardless of use level.

Perceived crowding is another approach to approximating an evaluative standard. Crowding is defined as "a negative evaluation of density" which involves a subjective judgment of appropriate use and encounter levels in a given area or activity (Shelby and Heberlein 1986). Crowding is perceived by a recreationist when the actual number of encounters with others surpasses the expected and/or preferred number of contacts (Kuentzel and Heberlein 1992). Examining the percentage of visitors who report feeling crowded in a particular setting is one way of determining the evaluative standard. It is then up to the researcher or manager to decide at what point levels of crowding perceptions change from acceptable to unacceptable. A second method of isolating an evaluative standard using perceived crowding is to plot perceived crowding against use or encounter levels in order to pinpoint sudden shifts, or "break points" (Shelby and

Heberlein 1986). If evident, these rapid increases in perceived crowding which occur with smaller increases in use or encounter level can be considered a social carrying capacity (Shelby and Heberlein 1986).

Research Findings

Social carrying capacity research, once focused primarily on the effects of use levels, has progressed to include complex studies involving social, personal, and situational factors that affect the way people evaluate density and ultimately, their recreational experience. Researchers have discovered that there is no single guaranteed visitor response to fluctuating use levels. Changes in visitors' attitudes and behaviors in each unique setting are affected by a number of interrelated impacts, most commonly, visitor encounters and environmental impacts (Graefe et al. 1984).

Manning and Ciali (1980) in their study of river recreationists in Vermont, further explored the satisfaction model and the psychological explanations as to why it can not be validated. As predicted, field data failed to produce the inverse relationship between density and user satisfaction. Three hypotheses were statistically supported in an attempt to explain the findings; the "no expectations" hypothesis, the "product shift" hypothesis, and the "displacement" hypothesis.

In a study of user satisfaction on two Oregon rivers, Shelby et al. (1988) found supporting evidence of visitor displacement and product shift coping behaviors. Nineteen percent of users on the Rogue River said they would decide to go to a more remote location the next time they went river running. Data also indicated displacement from the

Rogue River to the lesser used Illinois River. Product shift was evident by one third of the users on the Rogue River confirming that they saw more people than they expected and that they would change their expectations of the experience provided by the Rogue before becoming dissatisfied. Becker (1981) discovered similar user displacement as a means of accommodating personal density preferences among river recreationists.

Kuentzel and Heberlein (1992) identified intrasite displacement as an adequate coping mechanism for Apostle Islands boaters, illustrating that increasing use levels will not necessarily force more sensitive users to leave the area completely.

Backpackers in Great Smoky Mountains National Park primarily used physical coping behaviors to avoid encounters and interactions with other wildland users (Hammitt and Patterson 1991). For example, almost forty-five percent indicated that they camp out of sight of other groups whenever possible, twenty-seven percent said they avoid the park during peak use seasons, and twenty-one percent purposely avoid trails leading to popular attractions.

Carrying capacity research often involves measurement of encounters. Shelby and Colvin (1982) found that visitor recall and diary reports of encounters were most accurate at the lowest encounter levels. However, if it is not possible to utilize research personnel to record encounters, the user recall method is acceptable and cost efficient (Shelby and Colvin 1982). Although user recall is frequently implemented in social carrying capacity research, not having trained individuals report the exact number of contacts recreationists experience is a limitation in this type of study.

In analyzing the effectiveness of each of the three approaches to determining

evaluative standards in diverse recreational settings, Shelby and Heberlein (1986), identified the contact preference standard approach to determining social carrying capacity as being more useful than satisfaction or perceived crowding based on its social impact specificity and ability to be applied to a variety of settings.

Crowding has been a widely studied attribute of social carrying capacity, however defining how much is too much has remained a difficult task (Shelby 1981). Studying users on three American rivers, Shelby (1981) determined encounter norms based on respondents' beliefs of what the appropriate number of encounters should be for three different kinds of recreational experiences (wilderness, semi-wilderness, and undeveloped recreation). There was notable similarity of the situational encounter norms across the study areas, although results showed lesser agreement of appropriate encounter numbers for higher density experiences.

Schreyer and Roggenbuck (1978) studied the influence of recreationists' expectations on their perceptions of crowding. As expected, crowding perceptions increased with increasing encounter levels, however users placing a high level of importance on their expectations of stress release/solitude felt more crowded at all encounter levels than did those who placed low importance on achieving stress release/solitude. Schreyer and Roggenbuck concluded that crowding perceptions are a function of personal expectations for a particular recreational experience and the intensity of these expectations varies from person to person.

Effects of users' experience expectations and preferences on perceived crowding was investigated by Shelby et al. (1983). People were found to be tolerant if encounters

exceeded their personal preferences; however when encounters surpassed their expectations, users were likely to feel crowded.

A pilot carrying capacity program at Arches National Park, Visitor Experience and Resource Protection (VERP), was designed around visitor expectations in response to increasing use levels and crowding. Currently in use, it establishes a range of management zones that provide various degrees of solitude and visitor services. Visitation thresholds are in place to protect both the scenic and physical environment and use limitations can be enforced when visitor experiences and/or the environment deteriorate (Wilkinson 1995).

A comparative analysis study of crowding as a carrying capacity indicator conducted by Shelby et al. (1989) found that crowding varies by time, season, setting, resource availability, accessibility/convenience, and management strategies. Measuring crowding was identified as a useful method to include in determining social carrying capacity. Subjective guidelines were set for reported crowding which includes warning of capacity approach within areas reporting fifty to sixty-five percent perceived crowding and the existence of a definite capacity problem when more than sixty-five percent of the visitors feel crowded.

Social carrying capacity research can be facilitated more efficiently and purposefully when there is a cooperative effort between the scientists and the resource managers. Moore and Brickler (1987) incorporated a planning approach to their wilderness study in Arizona with the Bureau of Land Management. Communication and collaboration in the early stages of the study aided in identifying the problem focus and project development, and ultimately involved the managers in every aspect of the research effort.

Summary

Estimation of social carrying capacity is a difficult task due to the various psychological factors and variables involved in recreational experience quality. There is no one magic number for capacity; each setting and group of users is truly unique. Previous research indicates the contact preference standard as the superior singular approach in social capacity estimation. However, in light of this research, the difficulty in measuring social capacity illustrates the need to focus not only on one approach to determining capacity, but to collectively utilize data from all three approaches to gain a broader picture of user characteristics and produce a richer measure of social carrying capacity.

CHAPTER III

STUDY AREA

Of Midpeninsula's twenty-three preserves, three preserves were chosen for this study based on the following criteria:

1. For comparative reasons, three preserves with varying use levels were selected.
   - Los Trancos has a low use level with no more than 250 visitors on high use days.
   - Monte Bello has a medium use level with 250 to 500 visitors on high use days.
   - Rancho San Antonio has a high use level with over 500 visitors on high use days.
2. For consistency, all three preserves allow similar recreational opportunities; they provide trails for hiking, biking, and equestrian, but do not allow dogs. Additionally, dog walkers could potentially form a fourth user group. To limit the scope of this study, no more than three user groups to investigate per preserve were desired.

Los Trancos

This 274 acre preserve is located in the Santa Cruz Mountains above the city of Palo Alto. Two thousand feet above sea level, preserve users catch views of San Francisco and even Mount Diablo across the Bay on clear days (Figure 3). Of particular interest at Los Trancos is the San Andreas Fault Trail (Figure 4), an interpretive adventure along and across the famous fault which runs through the preserve. A total of five miles of trails through grassland, brushland, and oak forests are easily accessible. Parking is available in

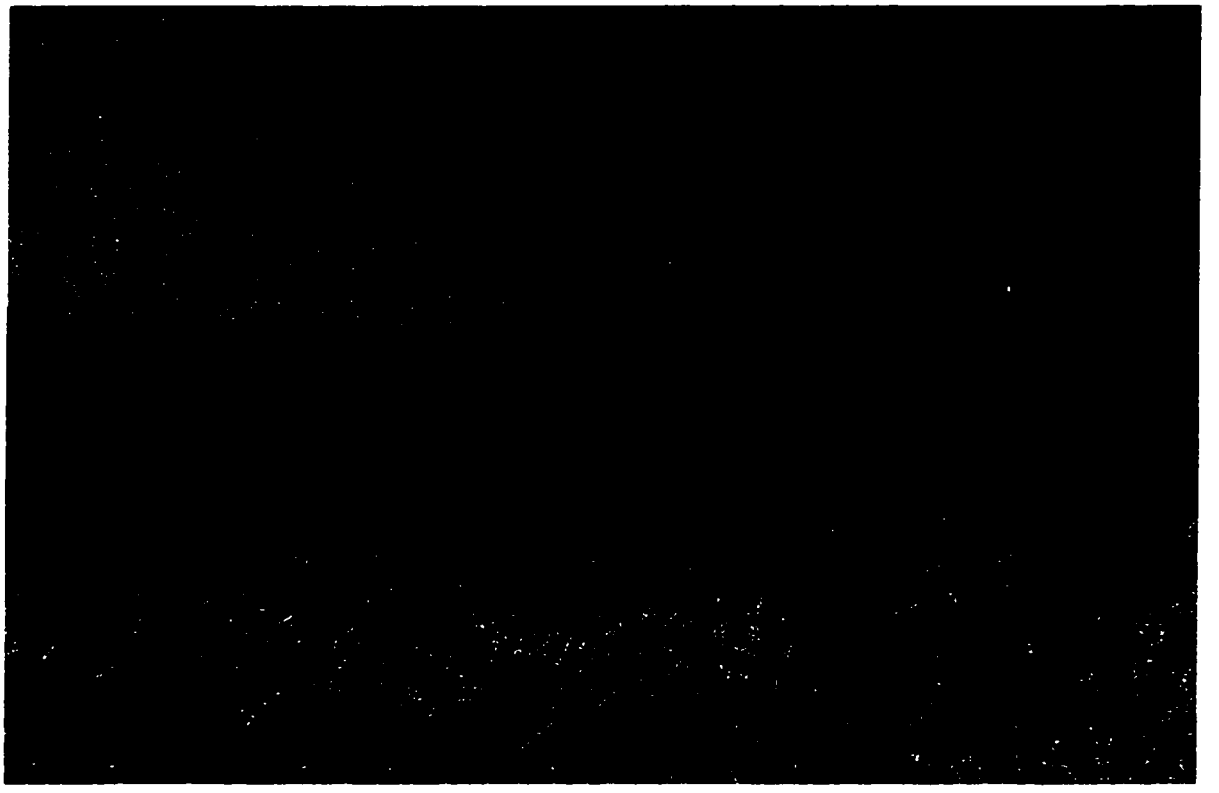

Fig. 3. View of the central San Francisco peninsula from Los Trancos hillside

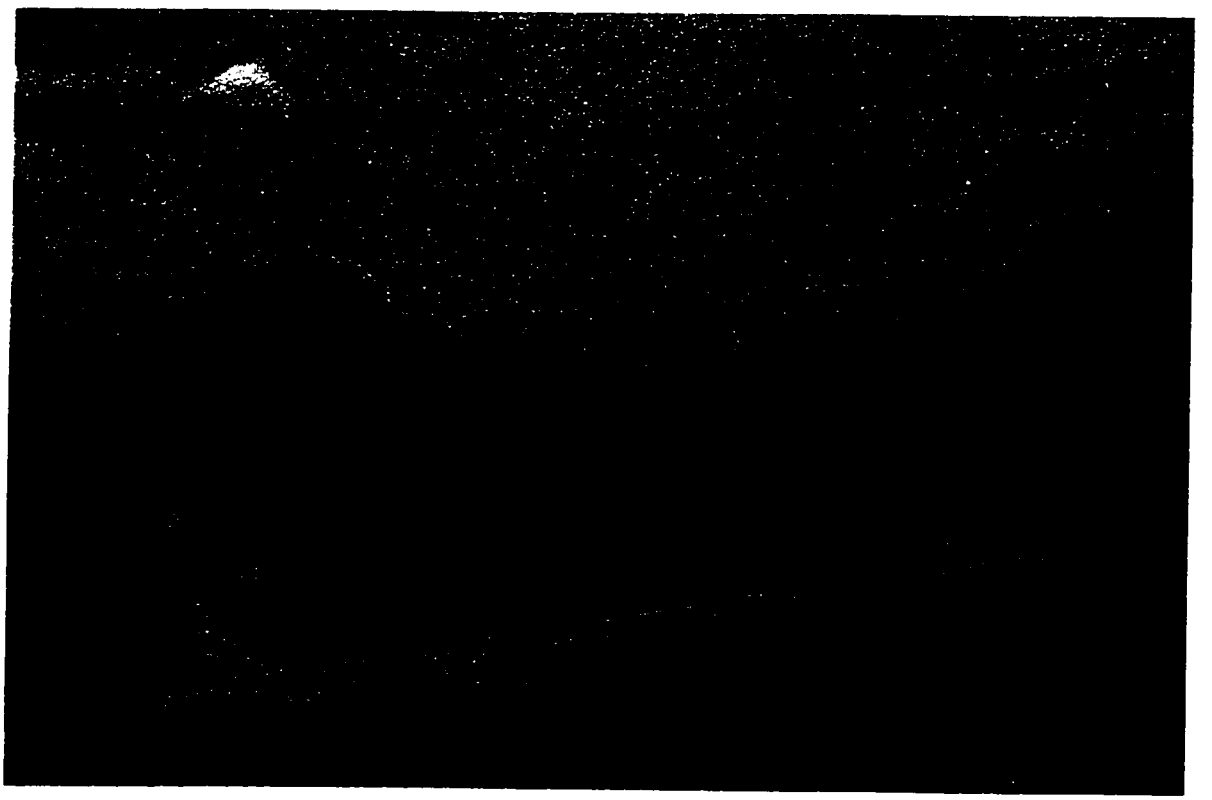

Fig. 4. Section of San Andreas Fault Trail at Los Trancos Preserve.

a lot at the preserve's entrance on Page Mill Road (Midpeninsula Regional Open Space District 1996b).

Monte Bello

A 2,758-acre preserve, Monte Bello (Figure 5) contains some of the District's richest wildlife and ecosystem diversity that can be easily explored along its fifteen miles of trails. The preserve's open grasslands (Figure 6) and dense riparian forests support a variety of wildlife including black-tailed deer, bobcats, coyotes, red-tail hawks, and turkey vultures. The geographic features of Monte Bello Ridge and Black Mountain located within the preserve provide users with spectacular vistas of the Santa Clara Valley and the Mount Hamilton Range. A large parking lot is situated at the preserve's main entrance directly across the street from the parking area at Los Trancos on Page Mill Road. (Midpeninsula Regional Open Space District 1996c).

Rancho San Antonio

Rancho San Antonio, located adjacent to the cities of Cupertino and Los Altos Hills, consists of 2,135 acres of grassy meadows and oak woodland (Figure 7). Diverse wildlife, including black-tailed deer, coyotes, and mountain lions, make the preserve's chaparral and canyons their home. Deer Hollow Farm (Figure 8), a working farm operated by the City of Mountain View, is a highlight of the preserve and is situated in the extreme eastern section of the preserve, about one and a half miles from the main parking lot located within the adjacent Rancho San Antonio County Park. Twenty-five miles of trails attract hikers, joggers, and equestrians; bicycles are allowed only on designated trails between the

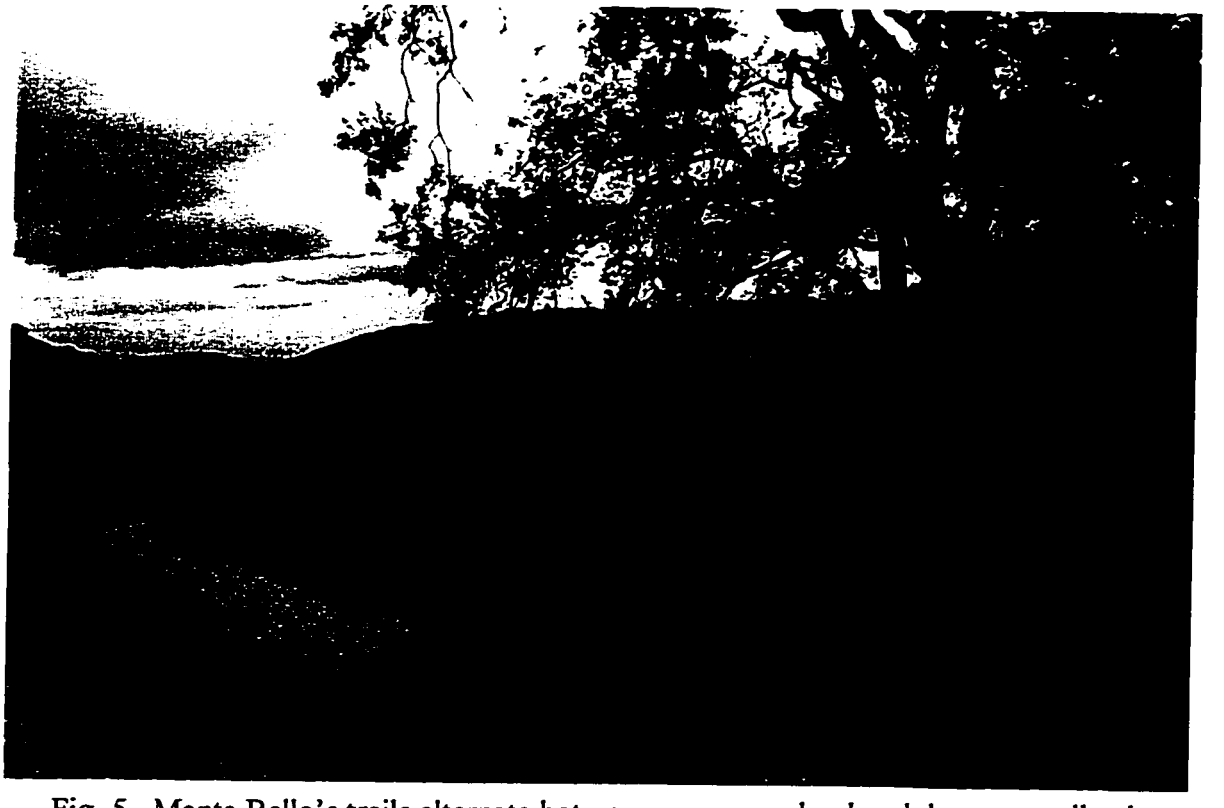

Fig. 5. Monte Bello's trails alternate between open grassland and dense woodland.

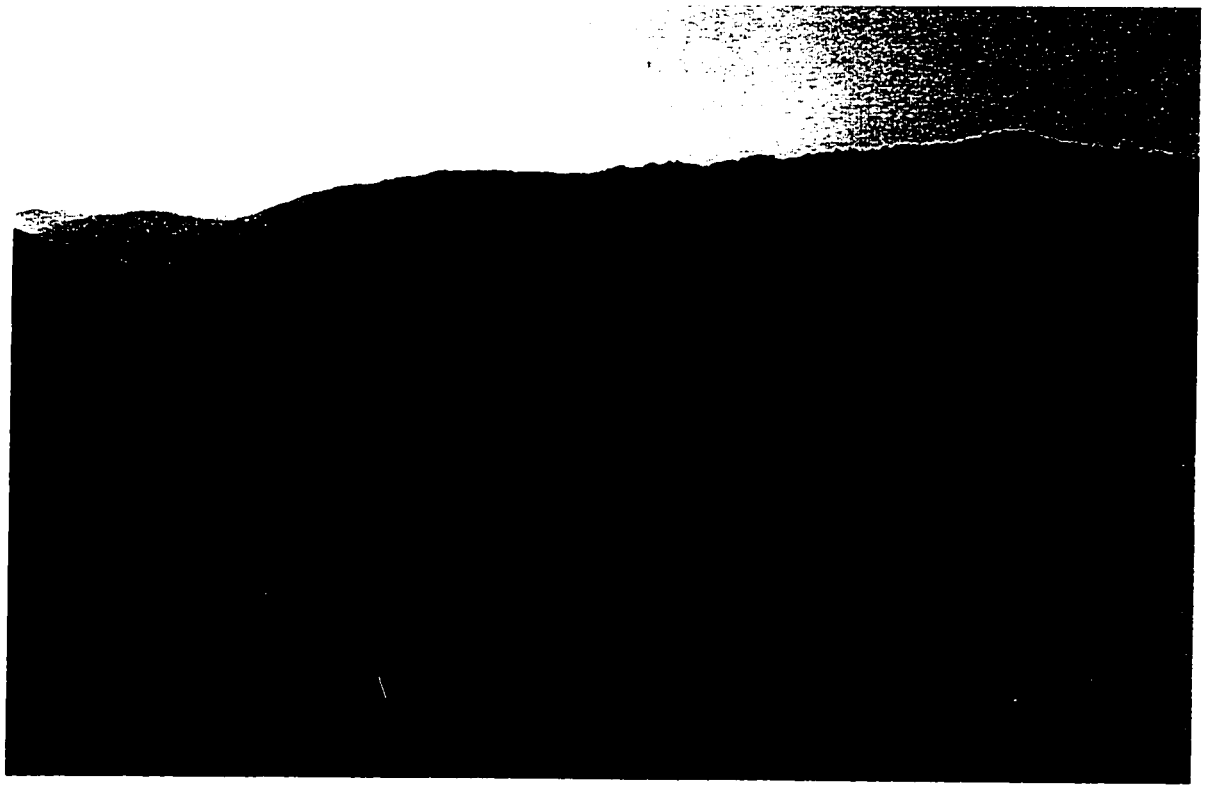

Fig. 6. Hilly grasslands along Monte Bello's Steven's Creek Nature Trail.

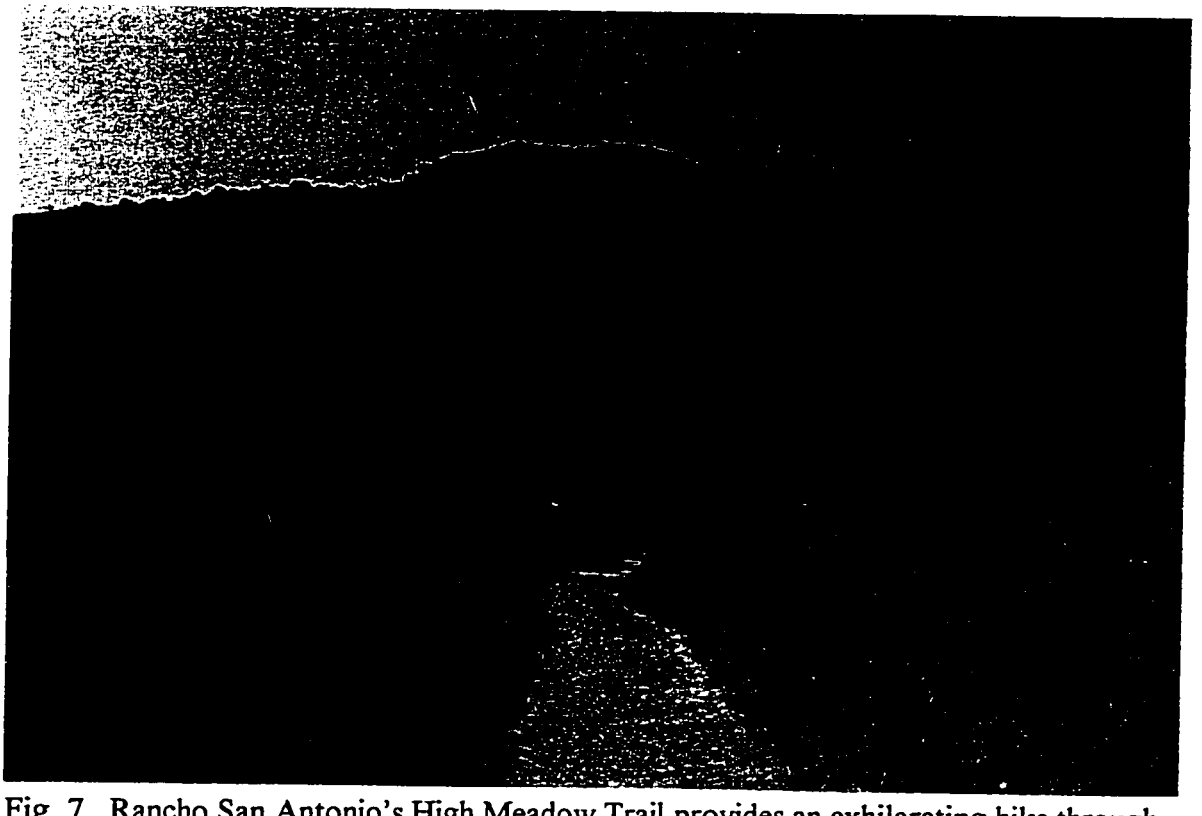

Fig. 7. Rancho San Antonio's High Meadow Trail provides an exhilarating hike through open grasslands and shady woodlands.

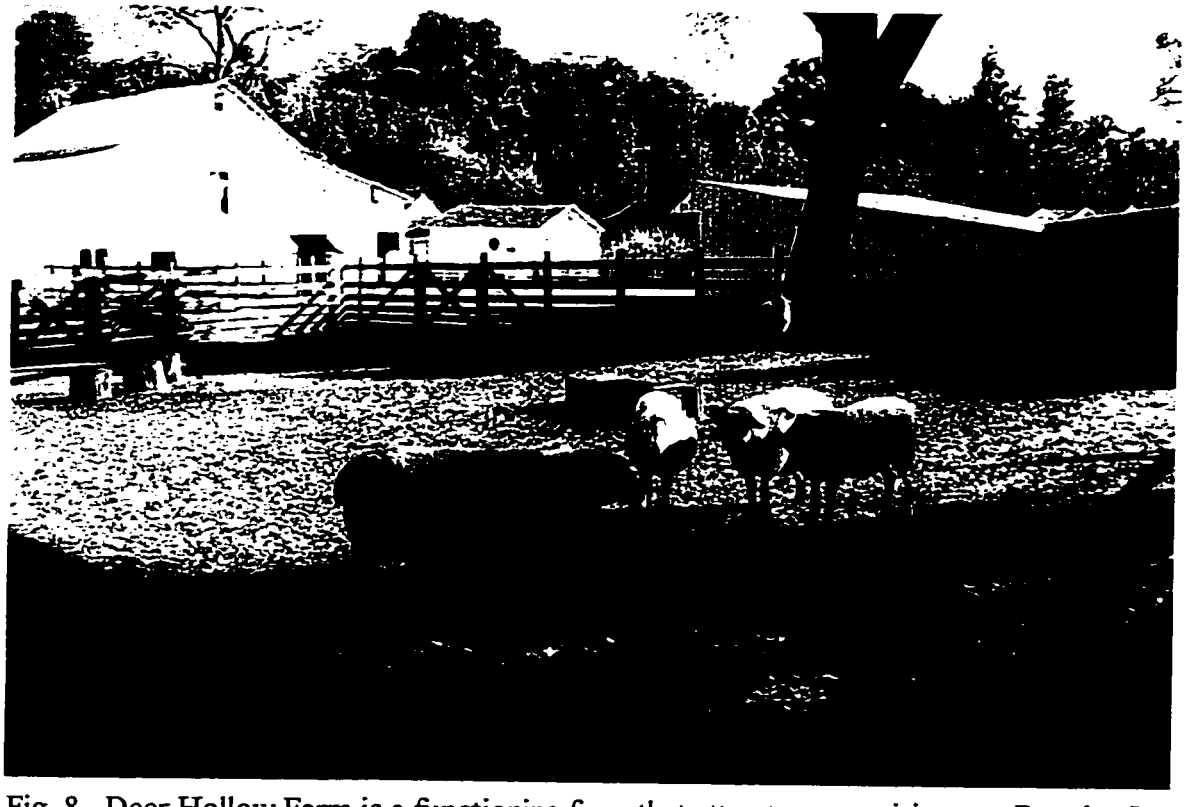

Fig. 8. Deer Hollow Farm is a functioning farm that attracts many visitors to Rancho San Antonio, particularly in the spring.

county park and Deer Hollow Farm (Midpeninsula Regional Open Space District 1996d).

CHAPTER IV

METHODOLOGY

Data Collection

Data for this study were collected by means of an exit questionnaire given to users as they left the main entrance of each preserve. To be comparable with earlier studies, the contents of the questionnaire were based on questions asked of recreationists in previous social capacity research conducted by Shelby (Shelby and Heberlein 1986, Shelby et al. 1988, Shelby et al. 1989). User groups surveyed included hikers and bicyclists at both Los Trancos and Monte Bello, and hikers, bicyclists, and joggers at Rancho San Antonio. Joggers are infrequently found at Monte Bello and Los Trancos Preserves and therefore, were not included in the study of these two sites. Although equestrians are allowed at all three preserves, unpublished use surveys conducted by Midpeninsula volunteers in 1995 and 1996 at various preserves, including Rancho San Antonio, indicate that they are not consistently present or present in significant numbers and therefore, were not included in this study.

Questionnaires were distributed in disproportionate stratified random samples to exiting members of each user group from sunrise to sunset at each preserve's main entrance. Because the actual population (use level) of each user group was not known until the end of a study day, proportionate samples could not be pre-determined. Due to dramatic differences in user group populations between the preserves, sampling techniques varied. Because of the considerably lower use levels at Los Trancos and Monte Bello

each exiting preserve user, excluding those who appeared less than eighteen years old, was approached to complete a survey. However, at Rancho San Antonio high use levels prevent the attempt to sample each user in a study of this size. A majority of the user population at Rancho San Antonio consists of hikers and joggers; members of these two user groups are continually found entering and exiting the preserve each hour from dawn until dusk. In order to obtain an adequate, representative sample from these two groups, four members from each group were approached for the survey at pre-determined random times each hour. If a particular user denied to participate in the survey, the next exiting member of that user group was approached. Bicyclists at Rancho San Antonio are far less numerous than hikers and joggers. Therefore, each exiting bicyclist, excluding those who appeared less than eighteen years old, at Rancho San Antonio was approached to complete a survey as in Los Trancos and Monte Bello preserves.

Shelby's previous social capacity research involved sample sizes ranging from 240 to 2,965 completed questionnaires (Shelby and Heberlein 1986). Sample sizes, after the elimination of incomplete and unusable surveys, and use levels for this study are illustrated in Table 1. See the following Preserve User Survey section for discussion of unusable surveys.

Table 1.--User Group Sample Sizes

Preserve	User Group	Day of Week	Combined User Group Population[a] for Both Days[b]	Combined Sample Size for Both Days
Los Trancos	Hikers	Tuesday	33	25
		Friday	50	35
		Sunday	177	60
	Bicyclists	Tuesday	10	7
		Friday	17	11
		Sunday	56	38
	Combined Total		343	176
Monte Bello	Hikers	Tuesday	32	20
		Friday	38	27
		Sunday	233	68
	Bicyclists	Tuesday	26	21
		Friday	33	26
		Sunday	116	48
	Combined Total		478	210
Rancho	Hikers	Tuesday	1683	91
		Friday	1902	95
		Sunday	4932	91
	Bicyclists	Tuesday	57	28
		Friday	63	29
		Sunday	220	54
	Joggers	Tuesday	1040	93
		Friday	1053	97
		Sunday	1135	95
	Combined Total		12,085	673

[a]Populations based on main entrance(s) use level counts only.
[b]Each preserve was studied on two Tuesdays, two Fridays, and two Sundays.

Each preserve was studied on a known low (Tuesday), medium (Friday), and high-use (Sunday) day of the week for two weeks in the spring of 1997. Springtime months were chosen because use levels tend to be higher than during other seasons. This resulted in a

total of six study days for each preserve, allowing for a more representative sample than a one week study. Data collection at Rancho San Antonio was conducted on April 15, 18, 20, 25, 27, and 29; at Monte Bello on May 6, 9, 11, 13, 16, and 18; and at Los Trancos on May 20 and 25, and June 1, 6, 10, 13. Because weather is a significant factor in visitation levels and field study was to take place on known typical low, medium, and high use days, rain and excessive heat caused the rescheduling of several survey days.

Preserve use levels for each survey day are represented by the number of people entering through the main entrance(s) of each preserve from sunrise to sunset. Entry counts through the main entrances at the preserves were tallied by the principal investigator. Volunteers were coordinated to staff the heavily used secondary entrance of Rancho San Antonio to assist in collecting entry level counts. Preserves have several remote, lesser used points of entry through which (according to District officials) only one to five percent of preserve users choose to enter. There are three of these tertiary entrances at Los Trancos, ten at Monte Bello, and three at Rancho San Antonio. Due to personnel limitations of this study, lesser used points of entry, other than the heavily used secondary entrance at Rancho San Antonio, were not monitored. Although exact visitation totals were not obtained, counting users at the main point(s) of entry for each preserve produced acceptable use level indices used to illustrate low, medium, and high use days and to perform correlation coefficient analyses where use level is a variable.

Preserve User Survey

To estimate the social carrying capacity of each preserve, evaluative standards must be

identified. The survey (Figure 3) includes questions that address the three approaches to determining evaluative standards: satisfaction, perceived crowding, and contact preference. In Figure 3, question 2 asks users to rate their experience satisfaction, question 2a asks visitors to indicate their primary reason for their dissatisfaction if they responded "poor" or "fair" in question 2, question 3 measures crowding perceived by the user, and question 4 determines contact preference standards for encounters with various user groups.

A pilot survey study conducted at Monte Bello and Rancho San Antonio prior to preserve data collection determined that 96% of all respondents identified 50 encounters or less as being the point where "neutral/pleasant" responses declined to "unpleasant" responses in question 4. Therefore, to reduce the amount of responses a participant would have to supply, question 4 was limited by asking recreationists how they felt about no more than 50 encounters. However, there are those preserve users who state that they do not find any number of encounters unpleasant. Because an infinite number of encounters can not be factored into a social carrying capacity estimate, surveys with no identified shift from a "neutral/pleasant" response to an "unpleasant" response to increasing encounters in question 4 were deemed unusable. The number of these types of unusable surveys is identified for reference for each preserve in the Contact Preference Standard Approach sections of Chapter Five. Although these surveys are unusable for calculations in this study, the number of respondents indicating no maximum tolerable encounter level should be noted as an additional statistic of user characteristics for each preserve.

Fig. 3. Preserve user survey.

Preserve _____ You are (circle one): hiker biker jogger Date _____
Time you arrived at preserve _____ Time you left preserve _____

1.) About how many hikers did you encounter within the preserve today? _____
About how many bikers did you encounter? _____ About how many joggers did you encounter? _____

2.) Overall, how would you rate your open space experience today? (check one)
_____ Poor _____ Fair _____ Good _____ Very Good _____ Excellent _____ Perfect

2a.) **If** you answered **Poor** or **Fair** in #2, what was the **primary** reason that your experience today was not better? (check only one)
_____ Weather (too hot/too cold) _____ Did not see wildlife _____ Other_____
_____ Too many other people (felt crowded) _____ Trails not interesting/challenging enough

3.) Did you feel that the preserve was crowded today? (circle one number)

1	2	3	4	5	6	7	8	9
Not at all		Slightly crowded		Moderately crowded			Extremely crowded	

4.) These questions will help us get an idea of how you react to seeing other visitors at this preserve. Do you find it a pleasant or unpleasant experience? Or does it make a difference? **Please answer all three sections.**

VU = Very unpleasant U = Unpleasant N = Neutral P = Pleasant VP = Very Pleasant

Section I. Refers to encountering hikers.

1. What would be your feelings about encountering no other users in the preserve, neither hikers, bikers, nor joggers?	VU	U	N	P	VP
2. What would be your feelings toward encountering 1 hiker today?	VU	U	N	P	VP
3. Toward encountering 5 hikers today?	VU	U	N	P	VP
4. Toward encountering 10 hikers today?	VU	U	N	P	VP
5. Toward encountering 15 hikers today?	VU	U	N	P	VP
6. Toward encountering 20 hikers today?	VU	U	N	P	VP
7. Toward encountering 30 hikers today?	VU	U	N	P	VP
8. Toward encountering 40 hikers today?	VU	U	N	P	VP
9. Toward encountering 50 hikers today?	VU	U	N	P	VP

*(Actual survey includes identical sections for encounters with bicyclists and joggers)

5.) Which best describes the type of recreational experience you desire at this preserve?

_____ An undeveloped, wilderness-like park with no developed trails, no facilities, no programs
_____ Semi-developed open space with marked trails, facilities, and interpretive exhibits (as it is now)
_____ A more developed, city-like park with tennis courts, barbecues, field sports, etc.

6.) Based on your response to #5, during your preserve visit, about how many encounters with other users (hikers, bicyclists, and joggers combined) would be the "right" amount for that type of recreational experience? _____

7.) Today, did you encounter more users than you had expected to? Y N **If no, go to #8.**

Fig. 3. Preserve user survey (continued).

If you encountered more users than you expected, did you:
change your thoughts about what type of recreational experience was being provided? Y N
decide to go to a less visited preserve next time? Y N
decide that the next time you visit this preserve, you will come at a less busy time? Y N
decide that the next time you visit this preserve, you will visit the less used trails? Y N

8.) Have you stopped using other preserves with higher visitation levels and chosen to use those that are less visited? (circle one) Always Sometimes Never
Have you stopped using this preserve during times of higher use because of the high volume of other users? (circle one) Always Sometimes Never
Have you stopped using the more frequently used trails at this preserve because of the high volume of people using them? (circle one) Always Sometimes Never

9.) Have you ever visited Rancho San Antonio Open Space Preserve? Y N
If "yes," have you stopped using that preserve because of its high visitation levels? (circle one)
Always Sometimes Never
*#9 only included on Monte Bello and Los Trancos surveys

Question 5 serves to identify a consensus on the type of recreation desired at the open space preserves. Question 6 serves to identify a consensus between user groups on the appropriate number of encounters for the desired type of recreation. According to Shelby and Heberlein (1986), a consensus on the type of recreation desired and the number of appropriate contacts for that recreational type must exist to determine social carrying capacity for a particular recreational area.

To examine the usage of psychological coping behaviors by preserve visitors, question 7 relates to product shift and future displacement and is directed only towards those users who encountered more people than they had expected. Question 8 is directed to all users and relates only to current displacement. Question 9 was included only on the Monte Bello and Los Trancos surveys to identify current displacement of these preserve users from Rancho San Antonio.

Data Analysis

Satisfaction

Question 2 of the user survey asked preserve visitors to rate their open space experience. Answers are analyzed by: (1) a frequency distribution of the satisfaction ratings for each user group at low, medium, and high use levels, (2) a frequency distribution of the satisfaction ratings for each user group at low, medium, and high encounter levels (low, medium, and high encounter divisions were made by dividing the range of reported encounters by three), and (3) correlation coefficient analysis between satisfaction and use level and satisfaction and encounter level. These analyses serve to illustrate any relationships between satisfaction and use levels and encounters. It should be noted that determination of significance for these and all correlation coefficients in this study is based on the Student's t where $p<.05$ is deemed significant.

If it is evident that satisfaction decreases with increasing use or encounter levels, social carrying capacity may be determined by identifying the number of encounters per visit hour at which satisfaction deteriorates to "fair/poor" conditions for a consensus (more than 50%) of the users, provided that their dissatisfaction is primarily due to feeling crowded (Shelby and Heberlein 1986). To identify those users whose dissatisfaction was a direct result of perceived crowding, question 2a asked these users why their experience was not better. Percentages of those indicating that their dissatisfaction was due to crowding are presented and discussed.

Perceived Crowding

The nine point scale in question 3, from the methodology of Shelby et al. (1989), asked users to rate their feelings of crowdedness. Analysis of perceived crowding includes: (1) a frequency distribution of the crowding ratings for each user group at low, medium, and high use levels, (2) a frequency distribution of crowding ratings for each user group at low, medium, and high use encounter levels, (3) a frequency distribution of satisfaction ratings for various levels of reported perceived crowding, and (4) correlation coefficient analysis between perceived crowding and use level, perceived crowding and encounter level, and perceived crowding and satisfaction. Social carrying capacity can be determined if perceived crowding is high. Shelby et al's (1989) subjective guidelines for carrying capacity determination based on perceived crowding percentages are shown in Table 2.

Table 2.--Carrying Capacity Judgment Based on Perceived Crowding Percentages

Percentage of Visitors Feeling Crowded	Capacity Judgment
0-35	Low crowding; unique low density experiences.
35-50	Low normal; problem situation does not yet exist.
50-65	High normal; capacity may be neared.
65-80	More than capacity; management actions necessary.
80-100	Much more than capacity; manage for high-density recreation or sacrifice area.

Source: Bo Shelby, Jerry J. Vaske, and Thomas A. Heberlein, Comparative Analysis of Crowding in Multiple Locations: Results From Fifteen Years of Research (London: Taylor and Francis, 1989) 11:269-291, table 4.

Using Table 2 (Shelby et al. 1989), social capacity can be defined as the number of encounters per visit hour that produce a perceived crowding response rate of sixty-five percent, provided that at least sixty-five percent of the respondents indicate some degree of crowding. If less than sixty-five percent of the survey respondents indicate some degree of crowding, social capacity can not easily be identified. However, these guidelines do provide managers and researchers with a general idea of where a particular recreational area lies in approaching its social carrying capacity.

Contact Preference Standard

Question 4 determines contact preference standards by asking users how they feel about various levels of encounters with specific user groups. Social capacity is identified as the average maximum tolerable encounter level--the point where the evaluations fall below neutral. Because the contact preference standard question identifies a respondent's maximum tolerable encounter level over the entire open space visit, these encounter levels were divided by the number of hours the person actually spent in the preserve in order to convert the contact preference standard into maximum tolerable encounters per visit-hour. Data from the encounter reports in question 1 were divided by the total number of hours each respondent spent in the preserve so that the actual number of encounters per visit-hour would be known. This encounter data was averaged for each user group to compare with the average maximum tolerable encounters per visit-hour identified for each user group to determine if social capacity is being exceeded overall and on any particular day.

Product Shift

To examine the presence of product shift, question 7 asks users who felt they encountered more people than they had expected if they had changed the way they thought about the type of recreational experience that the preserve offered. Percentages of "yes" responses for those responding are tabulated for each use level and overall at each preserve. Evidence of product shift can help explain differences in social capacity between similar recreation areas because visitors utilizing this coping behavior adapt to higher encounter levels. This expectation modification can create higher social carrying capacity at one preserve when compared to a preserve with lower capacity and no evidence of product shift amongst its users.

Displacement

Displacement is analyzed by three separate questions. Question 7 addresses future displacement by asking users who felt they had encountered more people than they had expected if they would decide to: (1) visit a less used preserve next time, (2) visit the same preserve at a less busy time next time, and 3) visit the less used trails of the preserve next time. Percentages of "yes" responses for those responding are tabulated for each use level and overall at each preserve.

Question 8 analyzes current displacement by asking all users if they: (1) purposely visit less used preserves, (2) have stopped using the preserve during high use time, and (3) have stopped using the more frequently used trails at the preserve. Responses to these questions are categorized as "always," "sometimes," and "never." Percentages for each

"always" and "sometimes" responses are tabulated for each use level and overall at each preserve.

Question 9 addresses preserve user displacement from Rancho San Antonio Open Space Preserve and was only included on the Los Trancos and Monte Bello surveys. Users were asked if they have ever visited Rancho San Antonio, and if so, have they stopped visiting that preserve because of its high visitation levels. Percentages for response categories of "always" and "sometimes" are tabulated for each use level and overall at both preserves.

When encounter sensitive users stop visiting a high use preserve, they will be replaced on average by less encounter sensitive users and social carrying capacity will rise at the high use preserve. Evidence of user displacement can help explain differences in social capacity between low and high use preserves. Because Rancho San Antonio experiences the highest use levels amongst Midpeninsula Regional Open Space District's 23 preserves, user displacement away from this preserve is a concern and is addressed by survey question 9.

Data Weighting

Because actual populations of user groups were unknown until after counting use levels for each study day, disproportionate stratified random samples were utilized for survey distribution. When combing data from the user groups (strata) in statistical calculations and social carrying capacity estimation, statistical weighting of the data is necessary. The weighting factor (Backstrom and Hursh-Cesar 1981) for the *i*th group is:

$$w_i = \frac{(P_i)(n_r)}{n_i(1 - P_i)}$$

w = weight
i = population (user group) being studied
P_i = correct proportion of the user group in the population
n_i = user group sample size
n_r = total combined sample size - n_i

Data Synthesis

Previous studies have illustrated positive correlations between dissatisfaction and crowding and between perceived crowding and contacts (Shelby and Heberlein 1986). Producing similar results, this study uses the satisfaction and perceived crowding data to cross check the determined contact preference standard (CPS). Table 3 presents a simple summary of how the contact preference standard is cross checked.

As illustrated in Table 3, if the contact preference standard is exceeded, then crowding should be the primary reason that dissatisfied users indicate to explain their dissatisfaction. If crowding is not the dominant reason it is possible that respondents were conservative in their answers regarding contact preference. Also, perceived crowding should be high if the contact preference standard is exceeded. If this is not the case, this data would further support the idea that the contact preference standard is too low and may need to be adjusted up to the next highest contact tolerance level.

Table 3.--Verification of Contact Preference Standard by Satisfaction and Perceived Crowding Data

If CPS is Exceeded	If CPS is not Exceeded
Dissatisfied Users Analysis: Should indicate crowding as primary reason for dissatisfaction. If not, CPS is possibly too low.	Dissatisfied Users Analysis: Should indicate reasons other than crowding as primary reason for dissatisfaction. If not, CPS is possibly overestimated.
Perceived Crowding Analysis: Perceived Crowding should be high. If not, CPS possibly too low.	Perceived Crowding Analysis: Perceived Crowding should be low. If not, CPS possibly overestimated.

If the contact preference standard is not exceeded, then dissatisfied users should indicate reasons other than crowding for their dissatisfaction. However, if crowding is the dominant reason for their dissatisfaction it is possible that respondents overestimated their contact preference standard. Also, perceived crowding should be low if the contact preference standard is not exceeded. If perceived crowding is high, this data would further support the idea that the contact preference standard is too high and may need to be adjusted down to the next lowest contact tolerance level.

Cross checking of the contact preference standard is the primary tool in refining the estimate of social carrying capacity in this study. Previous capacity research indicates that it is unlikely that the satisfaction approach alone will produce an estimation of social carrying capacity because although recreationists may feel crowded, they often still have an enjoyable, satisfying experience (Shelby and Heberlein 1986). However, the perceived crowding approach may yield an estimate of social capacity if capacity is being exceeded. In this case, this estimate of capacity will be compared to the capacity estimation obtained

from the verification of the contact preference standard described above. If the estimates of capacity differ by no more than 10 encounters per visit-hour, the two approaches will be considered in acceptable agreement and social capacity will be identified as the capacity determined by the contact preference standard. If the two approaches are not in agreement, further analysis and cross checking of the contact preference standard based on the degree of crowding responses will be conducted as summarized in Table 4.

Table 4.--Determination of Social Carrying Capacity by Comparison of Capacities Estimated by the Contact Preference Standard and Perceived Crowding Responses When Difference is Greater Than 10 Encounters/Visit-Hour

If CPS capacity estimation is greater than the capacity estimated by the perceived crowding approach (PC), then a majority of respondents should indicate "slight crowding" (3-4 on scale of 1-9). If so, then CPS estimation will be used as the measurement of capacity because visitors may find "slight" crowding tolerable--explaining the higher CPS. If not, capacity estimation will be based on the PC approach because the greater intensity of crowding felt by respondents indicates the contact level was not tolerable and the CPS is possibly too high.
If CPS capacity estimation is less than the capacity estimated by the PC approach, then a majority of respondents should indicate "moderate and extreme" crowding (5-9 on the scale). If so, then CPS estimation will be used as the measurement of capacity because visitors may find the crowding at that encounter level intolerable--explaining the lower CPS. If not, capacity estimation will be based on the PC approach because the lower intensity of crowding felt by respondents indicates that the contact level was tolerable and the CPS is possibly too low.

This study has not only produced estimations of social carrying capacity for the preserves, but has also created a detailed evaluation and understanding of these capacities and the characteristics of preserve users. As described in the above sections, data are

statistically analyzed and displayed for all three approaches to determining capacity and the two coping behaviors in order to illustrate the social state of the preserves and their users. Additionally, the role of psychological coping behaviors in preserve capacity differences is statistically analyzed and discussed.

CHAPTER V

RESULTS

Because this study involves the analysis of numerous variables at three separate open space preserves, the results are presented in totality for each individual preserve before discussing the next preserve. The results for Los Trancos are presented first, followed by Monte Bello and Rancho San Antonio, respectively.

According to Shelby and Heberlein (1986), before social carrying capacity can be determined for a particular area, three conditions must first be satisfied: (1) there must be a relationship between use level and encounter level, (2) there must be agreement among relevant user groups about the type of recreation experience to be provided, and (3) there must be some agreement among relevant user groups about appropriate levels of social impact (number of encounters per hour). The following data analysis results for each preserve begin with a brief illustration indicating how these three conditions have been satisfied.

Los Trancos

Shelby and Heberlein's (1986) three prerequisite conditions to estimating social carrying capacity are strongly met at Los Trancos as seen in Table 5. Use level and encounters per hour correlations illustrate a significantly positive, moderate relationship between the two variables. Both hikers and bicyclists overwhelmingly prefer the open

space recreation opportunities as are currently offered and a consensus agree that 10 to 15 encounters per hour are appropriate for this type of recreation.

Table 5.--Prerequisite Conditions for Determining Social Carrying Capacity at Los Trancos

User Group	Use Level & Encounters/Hr Correlation[a]	Percent Preferring Open Space Recreation as Current	Encounters/Hr Consensus
Hikers	.58	98%	60% say 10-15 enc/hr
Bicyclists	.55	100%	61% say 10-15 enc/hr

[a]$p<.001$

Satisfaction

To determine social carrying capacity using the satisfaction model approach, satisfaction must decrease with increasing use levels and a consensus of users must report dissatisfaction with their recreational experience. Satisfaction ratings in Table 6 show that a majority of visitors (72% to 100%) were highly satisfied ("excellent"/"perfect") at all three use levels, however there is a declining trend in satisfaction as use levels increase. Although correlation coefficient analysis of use level and satisfaction indicates a significantly negative, low relationship, no users reported a dissatisfying experience ("poor"/"fair" response). Therefore the satisfaction model is not supported and carrying capacity can not be determined using solely this approach.

Table 6.--Frequency Distribution of Satisfaction Ratings at Los Trancos for Various Use Levels

Percent Rating Satisfaction As				
Day of Week (use level)/ User Group (sample size)	Poor/Fair	Good/ Very Good	Excellent/ Perfect	Use Level-Satisfaction Correlation[a]
Tuesday (Low: 0-27)				
Hikers (25)	0%	20%	80%	
Bicyclists (7)	0%	0%	100%	
Combined Users (36)	0%	15%	85%	
Friday (Medium: 28-39)				
Hikers (35)	0%	17%	83%	
Bicyclists (11)	0%	9%	91%	
Combined Users (46)	0%	15%	85%	
Sunday (High: 40-146)				
Hikers (60)	0%	28%	72%	
Bicyclists (38)	0%	16%	84%	
Combined Users (98)	0%	27%	73%	
Combined Days & Users (176)	0%	21%	79%	-.24

[a]$p<.01$

Analysis of the relationship between encounters per hour and satisfaction is displayed in Table 7. Satisfaction responses indicate that a majority of visitors (65% to 100%) were highly satisfied at all three encounter levels. Respondents' satisfaction declines somewhat as encounter levels increase, although bicyclists' satisfaction responses do not exhibit this trend as solidly as hikers' satisfaction responses. Correlation coefficient analysis of encounters and satisfaction produced no relationship between these two variables.

Table 7.--Frequency Distribution of Satisfaction Ratings at Los Trancos for Various Encounter Levels

Percent Rating Satisfaction As				
Encounter Level Per Hr/ User Group (sample size)	Poor/Fair	Good/ Very Good	Excellent/ Perfect	Encounter Level-Satisfaction Correlation[a]
Low (0-8.9)				
Hikers (98)	0%	21%	79%	
Bicyclists (38)	0%	8%	92%	
Medium (9-17.9)				
Hikers (19)	0%	35%	65%	
Bicyclists (13)	0%	13%	87%	
High (18-27)				
Hikers (3)	0%	33%	67%	
Bicyclists (5)	0%	0%	100%	
Combined Encounter Levels & Users (176)	0%	21%	79%	-.09

[a]$p>.1$

It is not unexpected that satisfaction analysis in this study illustrates no definite correlations between use level/encounter level and satisfaction and provided no consensus of dissatisfied users. Previous studies have yielded similar findings based on the complexity of experience satisfaction. There are numerous elements that play a role in a recreationist's satisfaction other than use levels and the number of other users encountered. Visitor recreation expectations and the obtaining of personal goals are just two other factors among many that can influence satisfaction. The satisfaction model is too general and has not been a useful method for social carrying capacity determination in previous studies nor at Los Trancos.

Perceived Crowding

Crowding theory states that use levels influence the number of contacts between recreationists and that contacts influence feelings of crowding. Although both of these variables affect perceived crowding, the actual number of contacts appears to have the greater influence (Shelby et al. 1989). Table 8 illustrates the relationship between use levels and crowding at Los Trancos. No users surveyed felt crowded on the low and medium use days, however on the high use days where use levels jumped sharply, 23% of the hikers and 5% of the bicyclists reported some degree of crowding. Correlation analysis between these two variables produced a significantly positive, moderate relationship with 19% of crowding explained by use levels.

Table 8.--Frequency distribution of crowding ratings at Los Trancos for various use levels

	Percent Rating Crowding As				
Day of Week (use level)/ User Group (sample size)	Not At All	Slightly Crowded	Moderately Crowded	Extremely Crowded	Use Level-Crowding Correlation[a]
Tuesday (Low: 0-27)					
Hikers (25)	100%	0%	0%	0%	
Bicyclists (7)	100%	0%	0%	0%	
Combined Users (32)	100%	0%	0%	0%	
Friday (Medium: 28-39)					
Hikers (35)	100%	0%	0%	0%	
Bicyclists (11)	100%	0%	0%	0%	
Combined Users (46)	100%	0%	0%	0%	
Sunday (High: 40-146)					
Hikers (60)	77%	17%	6%	0%	
Bicyclists (38)	95%	5%	0%	0%	
Combined Users (98)	79%	15%	6%	0%	
Combined Days & Users	90%	7%	3%	0%	.44

[a]$p<.001$

As expected, the relationship between encounter levels and crowding is stronger than the use level/crowding relationship (Table 9). Correlation between encounters and crowding illustrates a significantly positive, moderate relationship with 27% of crowding explained by contacts. Although the sample size of users experiencing high contact levels is not large enough to merit crowding analysis, data from users at low and medium contact levels show a strong rise in reported crowding as contacts increase. At low contact levels, only 6% of hikers and no bicyclists reported some degree of crowding. However, at medium encounter levels, 32% of hikers and 8% of bicyclists reported some degree of crowding. Based on these findings and the strength of the correlation, it is expected that percentages of reported crowding would continue to increase as contacts levels rise.

Table 9.--Frequency Distribution of Crowding Ratings at Los Trancos for Various Encounter Levels

	Percent Rating Crowding As				
Encounter Level Per Hr/ User Group (sample size)	Not At All	Slightly Crowded	Moderately Crowded	Extremely Crowded	Encounter Level-Crowding Correlation[a]
Low (0-8.9)					
Hikers (98)	94%	6%	0%	0%	
Bicyclists (38)	100%	0%	0%	0%	
Medium (9-17.9)					
Hikers (19)	68%	21%	11%	0%	
Bicyclists (13)	92%	8%	0%	0%	
High (18-27)					
Hikers (3)	33%	0%	67%	0%	
Bicyclists (5)	80%	20%	0%	0%	
Combined Encounter Levels & Users (176)	90%	7%	3%	0%	.52

[a]$p<.001$

As previously discussed, because of the complexity of an individual's experience satisfaction, it is expected that the effect of any one variable on satisfaction would be small. The correlation between crowding and satisfaction, although statistically significant, is small and perceived crowding explains only 8% of the variance in satisfaction (Table 10). All visitors surveyed reported being satisfied regardless of the degree of perceived crowding they experienced.

Table 10.--Perceived Crowding and Satisfaction Ratings at Los Trancos

	Percent Rating Satisfaction As			
Crowding Rating/ User Group (sample size)	Poor/Fair	Good/ Very Good	Excellent/ Perfect	Crowding-Satisfaction Correlation[a]
Not at All Crowded				
Hikers (106)	0%	21%	79%	
Bicyclists (54)	0%	13%	87%	
Slightly Crowded				
Hikers (10)	0%	40%	60%	
Bicyclists (2)	0%	0%	100%	
Moderately Crowded				
Hikers (4)	0%	50%	50%	
Bicyclists (0)	-	-	-	
Extremely Crowded				
Hikers (0)	-	-	-	
Bicyclists (0)	-	-	-	
Combined Encounter Levels & Users (176)	0%	21%	79%	-.28

[a]$p<.001$

In order to estimate social carrying capacity based on perceived crowding alone, capacity would have to be reached at the recreation area. According to Table 2 (Shelby et al. 1989) in Chapter 4, social carrying capacity is exceeded when approximately 65% of

the survey respondents indicate some degree of crowding. However, at Los Trancos data show that even on the highest use days, crowding is not yet a significant problem. Twenty-three percent of Sunday hikers and 8% of Sunday bicyclists felt some degree of crowding on these high use days. Analysis of all data combined for the three use levels indicates that overall only 10% of the respondents felt some degree of crowding.

Reported crowding percentages at various encounter levels also indicate that capacity has not been exceeded. The large majority of respondents (77%) experienced low encounter levels ranging from 0 to 8.9 encounters per hour. At these encounter levels, only 6% of the hikers and no bicyclists felt crowded. At medium contact levels ranging from 9 to 17.9 encounters per hour, 32% of the hikers and 8% of the bicyclists felt crowded. Utilizing the Capacity Judgment Table 2 in Chapter 4, (Shelby et al. 1989), these low percentages of reported crowding at various use and encounter levels indicate that Los Trancos has not reached its carrying capacity and is an area with opportunities for low density experiences. Because social carrrying capacity has not been exceeded, capacity at Los Trancos can not be estimated using perceived crowding alone.

Contact Preference Standard

When using only one method to determine social carrying capacity, the contact preference standard is the preferred approach because it addresses capacity in terms of contacts with other users; recreationists directly express their tolerable number of encounters with others (Shelby and Heberlein 1986). As discussed in Chapter 4, surveys whose respondents indicated no shift from a "neutral/pleasant" response to an

"unpleasant" response to increasing encounters in question 4 were discarded. In the Los Trancos samples, 3 hiker surveys and 1 bicyclist survey were unusable based on this criteria. Contact preference standards for Los Trancos users are displayed in Table 11. Social carrying capacity estimations based on contact preference standard data are summarized in Table 12. Actual encounter levels were well below all contact preference standards. No contact preference standards were exceeded for any user group, any day of the week, or overall, and therefore, based on this approach, social carrying capacity at Los Trancos is not currently being reached.

Table 11.--Contact preference standards (CPS) in encounters per hour at Los Trancos

Day of Week (use level)/ User Group (sample size)	Hiker CPS	Actual Hikers Encountered/Hr	Bicyclist CPS	Actual Bicyclists Encountered/Hr	Total CPS	Actual Total Encounters Experienced/Hr
Tuesday (Low: 0-27)						
Hikers (25)	29	2	17	0.3	46	2.3
Bicyclists (7)	34	2	33	0.5	67	2.5
Users Combined (32)	30	2	21	0.4	51	2.4
Friday (Medium: 28-39)						
Hikers (35)	25	1	13	0.3	38	1.3
Bicyclists (11)	33	2	36	1	69	3
Users Combined (46)	27	1	19	0.5	46	1.5
Sunday (High: 40-146)						
Hikers (60)	24	7	10	1	34	8
Bicyclists (38)	25	8	24	2	49	10
Users Combined (98)	24	7	12	1	36	8
Combined Days & Users (176)	26	4	15	1	41	5

Table 12.--Social Carrying Capacities for Each Study Day and Overall at Los Trancos Using the Contact Preference Standard Approach

Day of Week (use level)	Social Carrying Capacity (Enc/Hr)	Actual Encounters/Hr
Tuesday (Low: 0-27)	51	2.4
Friday (Medium: 28-39)	46	1.5
Sunday (High: 40-146)	36	8
Combined Days	41	5

Social Carrying Capacity Based on Data Synthesis of all Three Approaches

Analysis of Los Trancos data produced significant correlations between perceived crowding and satisfaction and perceived crowding and contacts, therefore social carrying capacity as identified by the contact preference standard approach can be cross checked by utilizing data from the two other approaches. Table 12 above shows that social carrying capacities based on contact preference standards were not exceeded at any use level or overall. To verify the accuracy of these social capacity estimates in this case, it is expected that a majority of dissatisfied users indicate reasons other than crowding as their primary reason for dissatisfaction and that perceived crowding is low, or below capacity based on the perceived crowding approach. Because there were no dissatisfied respondents at Los Trancos, satisfaction data can not be used to cross check the contact preference standards, however perceived crowding data can be utilized. As seen in Table 8, perceived crowding is low for the various use levels and overall, ranging from 0% to 15% of respondents reporting feeling some degree of crowding at the various use levels

and only 10% of all respondents indicating some degree of crowding. Perceived crowding data is supportive of the determined contact preference standards; social carrying capacity is not currently being exceeded at various use levels or overall at Los Trancos. Because the two approaches are in agreement, social carrying capacity estimates based on the contact preference standard approach will not be adjusted and will be considered the best estimates of social carrying capacity for Los Trancos.

Product Shift

When users change their definitions of recreational experiences to cope with excessive encounters, they can have an effect on social carrying capacity. By using product shift coping behavior, users psychologically adapt to higher encounter levels to maintain recreational experience satisfaction. As increasingly more users employ product shift behavior at a preserve, social carrying capacity may rise.

Few users at Los Trancos reported encountering more people than they had expected; those who did were hiking on high use days (Sunday) and represented only 6% of the total Sunday sample. None of these recreationists reported using product shift coping behavior.

Displacement

Recreationists who encounter more users than they had expected may utilize displacement behaviors on their next preserve visit. Future displacement may have an effect on social carrying capacity as users react to higher encounter levels by no longer visiting a preserve, visiting the preserve at less busy times, or spreading out onto the less used trails. This physical displacement of density sensitive users can cause social carrying

capacity to rise at a particular preserve as these users are replaced by less density sensitive users.

As mentioned above, the only survey respondents indicating that they had encountered more users than expected were hikers on Sunday who represented 7% of the Sunday hiker sample and 6% of the total Sunday sample. Of these respondents, none indicated that they would visit a less used preserve next time, 50% said they would return to Los Trancos at a less busy time next visit, and 50% said they would utilize the less used trails on their next visit to the preserve.

Although future user displacement does not appear to be of immediate concern at Los Trancos, survey respondents indicated high levels of current intersite displacement behavior. Table 13 illustrates current intersite displacement of Los Trancos users from high use preserves to less used preserves like Los Trancos. Forty percent of all survey respondents indicated that they sometimes avoid high use preserves and choose to visit less used preserves and 5% said that they always avoid visiting the high use preserves.

Table 13.--Current intersite displacement of Los Trancos respondents to lesser used preserves

	Percent Reporting That They Have Stopped Using High Use Preserves and Choose to Visit Less Used Preserves	
Day of Week (use level)/ User Group (sample size)	"Always"	"Sometimes"
Tuesday (Low Use)		
Hikers (25)	0%	32%
Bicyclists (7)	0%	43%
Users Combined (32)	0%	35%
Friday (Medium Use)		
Hikers (35)	11%	37%
Bicyclists (11)	0%	36%
Users Combined (46)	8%	37%
Sunday (High Use)		
Hikers (60)	7%	47%
Bicyclists (38)	0%	37%
Users Combined (98)	6%	45%
Combined Days & Users (176)	5%	40%

Temporal displacement of Los Trancos visitors (Table 14) is not significant at this time. Only 7% of the respondents reported that they sometimes avoid visiting the preserve during high use times and less than 1% said that they always visit during low use times.

Table 14.--Current Time Displacement of Respondents at Los Trancos

	Percent Reporting That They Have Stopped Using Los Trancos During High Use Times	
Day of Week (use level)/ User Group (sample size)	"Always"	"Sometimes"
Tuesday (Low Use)		
Hikers (25)	0%	0%
Bicyclists (7)	0%	0%
Users Combined (32)	0%	0%
Friday (Medium Use)		
Hikers (35)	0%	9%
Bicyclists (11)	0%	0%
Users Combined (46)	0%	6%
Sunday (High Use)		
Hikers (60)	2%	12%
Bicyclists (38)	0%	0%
Users Combined (98)	1%	10%
Combined Days & Users (176)	<1%	7%

Intrasite displacement of Los Trancos users is similarly uncommon (Table 15). Only 9% of all respondents indicated that they sometimes avoid the more frequently used trails and less than 1% always choose the less used trails.

Table 15.--Current Intrasite Displacement of Respondents at Los Trancos

	Percent Reporting That They Have Stopped Using More Frequently Used Trails at Los Trancos	
Day of Week (use level)/ User Group (sample size)	"Always"	"Sometimes"
Tuesday (Low Use)		
Hikers (25)	0%	0%
Bicyclists (7)	0%	0%
Users Combined (32)	0%	0%
Friday (Medium Use)		
Hikers (35)	0%	11%
Bicyclists (11)	0%	0%
Users Combined (46)	0%	8%
Sunday (High Use)		
Hikers (60)	2%	13%
Bicyclists (38)	0%	3%
Users Combined (98)	1%	12%
Combined Days & Users (176)	<1%	9%

Displacement data of Los Trancos users specifically from Rancho San Antonio (Table 16) indicates that just over one-third of the survey respondents have visited Rancho San Antonio. Of those users who have been to Rancho San Antonio, 61% say that they sometimes choose not to visit the preserve because of its high use levels and 17% reported that they always avoid visiting Rancho San Antonio for this reason.

Table 16.--Current Intersite Displacement of Respondents at Los Trancos From Rancho San Antonio

	Percent Reporting That They Have Visited Rancho San Antonio and Have Stopped Visiting There Because of its High Use Levels		
Day of Week (use level)/ User Group (sample size)	% Who Have Visited RSA	"Always" Avoid RSA	"Sometimes" Avoid RSA
Tuesday (Low Use)			
Hikers (25)	32%	0%	50%
Bicyclists (7)	57%	25%	75%
Users Combined (32)	38%	9%	59%
Friday (Medium Use)			
Hikers (35)	31%	0%	73%
Bicyclists (11)	36%	50%	50%
Users Combined (46)	33%	15%	66%
Sunday (High Use)			
Hikers (60)	38%	26%	61%
Bicyclists (38)	29%	45%	55%
Users Combined (98)	37%	26%	60%
Combined Days & Users (176)	35%	17%	61%

Monte Bello

The three prerequisite conditions to estimating social carrying capacity (Shelby and Heberlein 1986) are met at Monte Bello and displayed in Table 17. Use level and encounters per hour correlations illustrate a significantly positive, moderate to high relationship between the two variables for hikers and bicyclists respectively. Nearly all users prefer the open space recreation opportunities as are currently offered and a consensus agree that 10 to 20 encounters per hour are appropriate for this type of recreation. A consensus of bicyclists agreed that 10 to 15 encounters per hour was appropriate, however slightly less than 50% of the hikers thought so, therefore the encounters per hour spread was increased to 10 to 20. Although this range is slightly greater, the high percentages in agreement are sufficient to support the prerequisite condition.

Table 17.--Prerequisite Conditions for Determining Social Carrying Capacity at Monte Bello

User Group	Use Level & Encounters/Hr Correlation[a]	Percent Preferring Open Space Recreation as Current	Encounters/Hr Consensus
Hikers	.64	97%	69% say 10-20 enc/hr
Bicyclists	.80	100%	80% say 10-20 enc/hr

[a]$p<.001$

Satisfaction

Satisfaction ratings in Table 18 show that a great majority of visitors (81% to 96%) were highly satisfied ("excellent"/"perfect") at all three use levels and only 1% of all survey respondents were dissatisfied with their open space experience. Correlation coefficient analysis between use level and satisfaction produced no significant relationship between the two variables. The satisfaction model is not supported and carrying capacity can not be determined using the satisfaction approach alone.

Table 18.--Frequency Distribution of Satisfaction Ratings at Monte Bello for Various Use Levels

	Percent Rating Satisfaction As			
Day of Week (use level)/ User Group (sample size)	Poor/Fair	Good/ Very Good	Excellent/ Perfect	Use Level-Satisfaction Correlation[a]
Tuesday (Low: 0-34)				
Hikers (20)	0%	10%	90%	
Bicyclists (21)	0%	5%	95%	
Combined Users (41)	0%	8%	92%	
Friday (Medium: 35-37)				
Hikers (27)	0%	4%	96%	
Bicyclists (26)	0%	11%	89%	
Combined Users (53)	0%	7%	93%	
Sunday (High: 38-195)				
Hikers (68)	3%	16%	81%	
Bicyclists (48)	0%	12%	88%	
Combined Users (116)	2%	15%	83%	
Combined Days & Users (210)	1%	12%	87%	-.15

[a] $p>.01$

Satisfaction ratings at various encounter levels are displayed in Table 19. Satisfaction responses indicate that a majority of visitors (60% to 100%) were highly satisfied at all three encounter levels. Respondents' satisfaction declines as encounter levels increase, although the bicyclists' satisfaction responses do not exhibit this as solidly as the hikers' satisfaction responses. Correlation coefficient analysis of encounters and satisfaction produced no relationship between these two variables.

Table 19.--Frequency Distribution of Satisfaction Ratings at Monte Bello for Various Encounter Levels

	Percent Rating Satisfaction As			
Encounter Level Per Hr/ User Group (sample size)	Poor/Fair	Good/ Very Good	Excellent/ Perfect	Encounter Level-Satisfaction Correlation[a]
Low (0-8.9)				
Hikers (88)	1%	9%	90%	
Bicyclists (62)	0%	8%	92%	
Medium (9-17.9)				
Hikers (22)	5%	18%	77%	
Bicyclists (28)	0%	18%	82%	
High (18-28)				
Hikers (5)	0%	40%	60%	
Bicyclists (5)	0%	0%	100%	
Combined Encounter Levels & Users (210)	1%	12%	87%	-.09

[a] $p>.09$

Perceived Crowding

Table 20 illustrates the relationship between use level and perceived crowding at Monte Bello. No users felt crowded on the low and medium use days, however 21% of the users on the high use Sundays felt some degree of crowding. Overall, only 10% of the users experience some degree of crowding. Correlation coefficient analysis between use levels and crowding produced a significantly positive, moderate relationship with 18% of crowding explained by use levels.

Table 20.--Frequency Distribution of Crowding Ratings at Monte Bello for Various Use Levels

	Percent Rating Crowding As				
Day of Week (use level)/ User Group(sample size)	Not At All	Slightly Crowded	Moderately Crowded	Extremely Crowded	Use Level-Crowding Correlation[a]
Tuesday (Low: 0-34)					
Hikers (20)	100%	0%	0%	0%	
Bicyclists (21)	100%	0%	0%	0%	
Combined Users (41)	100%	0%	0%	0%	
Friday (Medium: 35-37)					
Hikers (27)	100%	0%	0%	0%	
Bicyclists (26)	100%	0%	0%	0%	
Combined Users (53)	100%	0%	0%	0%	
Sunday (High: 38-195)					
Hikers (68)	81%	12%	7%	0%	
Bicyclists (48)	85%	15%	0%	0%	
Combined Users (116)	79%	15%	6%	0%	
Combined Days & Users	90%	7%	3%	0%	.43

[a] $p<.001$

Unexpectedly, the relationship between encounter levels and crowding, although significant, was not as strong as the relationship between use level and crowding (Table 21). Only 11% of crowding is explained by encounter levels. At low encounter levels, only 4% of hikers and 5% of bicyclists felt some degree of crowding. However, at medium encounter levels, a dramatic increase in reported crowding by hikers is evident. Although only 10% of bicyclists felt crowded at medium encounter levels, 45% of hikers reported some degree of crowding. Sample sizes of users experiencing high encounter levels are not large enough to analyze.

Table 21.--Frequency Distribution of Crowding Ratings at Monte Bello for Various Encounter Levels

	Percent Rating Crowding As				
Encounter Level Per Hr/ User Group(sample size)	Not At All	Slightly Crowded	Moderately Crowded	Extremely Crowded	Encounter Level-Crowding Correlation[a]
Low (0-8.9)					
Hikers (88)	96%	3%	1%	0%	
Bicyclists (62)	95%	5%	0%	0%	
Medium (9-17.9)					
Hikers (22)	55%	25%	20%	0%	
Bicyclists (28)	90%	10%	0%	0%	
High (18-28)					
Hikers (5)	100%	0%	0%	0%	
Bicyclists (5)	80%	20%	0%	0%	
Combined Encounter Levels & Users (210)	90%	7%	3%	0%	.33

[a]$p<.001$

The relationship between perceived crowding and satisfaction is illustrated in Table 22. Although there is a significantly negative relationship between the two variables, it is small with perceived crowding explaining only 5% of the variance in satisfaction. Overall, 99% of the visitors surveyed reported being satisfied regardless of the degree of crowding they experienced.

Table 22.--Perceived Crowding and Satisfaction Ratings at Monte Bello

	Percent Rating Satisfaction As			
Crowding Rating/ User Group (sample size)	Poor/Fair	Good/ Very Good	Excellent/ Perfect	Crowding-Satisfaction Correlation[a]
Not at All Crowded				
Hikers (102)	1%	11%	88%	
Bicyclists (88)	0%	11%	89%	
Slightly Crowded				
Hikers (8)	0%	13%	87%	
Bicyclists (7)	0%	14%	86%	
Moderately Crowded				
Hikers (5)	20%	40%	40%	
Bicyclists (0)	-	-	-	
Extremely Crowded				
Hikers (0)	-	-	-	
Bicyclists (0)	-	-	-	
Combined Encounter Levels & Users (210)	1%	12%	87%	-.23

[a] $p<.001$

Perceived crowding data at Monte Bello indicates that even on the highest use days and encounter levels, crowding is not yet a significant problem. Nineteen percent of Sunday hikers and 15% of Sunday bicyclists reported some degree of crowding on these high use days. Overall, only 10% of all respondents reported some degree of crowding.

Analysis of perceived crowding of hikers at various encounter levels indicates that 45% of those experiencing from 9 to 17.9 contacts during their visit felt some degree of crowding. Although this percentage appears high, social carrying capacity for hikers at this encounter level was not exceeded according to the Capacity Judgment Table 2 in Chapter 4 (Shelby et al. 1989). At this encounter level, Monte Bello remains below capacity, offering low to normal crowding conditions.

Contact Preference Standard

Contact preference standards for Monte Bello users are displayed in Table 23. It should be noted that 7 hiker surveys and 5 bicyclist surveys were discarded as unusable based on their lack of transition from a "neutral/pleasant" response to an "unpleasant" response to increasing encounters in survey question 4. Social carrying capacity estimations for the three days of the week and overall based on contact preference standards are summarized in Table 24. Actual encounter levels were well below all contact preference standards. No contact preference standards were exceeded for any user group, any day of the week, or overall, and therefore based on this approach, social carrying capacity at Monte Bello is not currently being reached.

Table 23.--Contact preference standards (CPS) in encounters per hour at Monte Bello

Day of Week (use level)/ User Group (sample size)	Hiker CPS	Actual Hikers Encountered/Hr	Bicyclist CPS	Actual Bicyclists Encountered/Hr	Total CPS	Actual Total Encounters Experienced/Hr
Tuesday (Low: 0-34)						
Hikers (20)	28	1	15	1	43	2
Bicyclists (21)	34	1	41	1	75	2
Users Combined (41)	31	1	25	1	56	2
Friday (Medium: 35-37)						
Hikers (27)	22	1.5	12	1	34	2.5
Bicyclists (26)	28	1.5	33	1.5	61	3
Users Combined (53)	25	1.5	21	1	46	2.5
Sunday (High: 38-195)						
Hikers (68)	21	6	14	3	35	9
Bicyclists (48)	26	7	27	5	53	12
Users Combined (116)	22	6	17	4	39	10
Combined Days & Users (210)	24	4	19	2	43	6

Table 24.--Social Carrying Capacities for Each Study Day and Overall at Monte Bello Using the Contact Preference Standard Approach

Day of Week (use level)	Social Carrying Capacity (Enc/Hr)	Actual Encounters/Hr
Tuesday (Low: 0-34)	56	2
Friday (Medium: 35-37)	46	2.5
Sunday (High: 38-195)	39	10
Combined Days	43	6

Social Carrying Capacity Based on Data Synthesis of all Three Approaches

Analysis of Monte Bello data produced significant relationships between perceived crowding and satisfaction and perceived crowding and contacts, therefore social carrying capacity as estimated by the contact preference standard approach can be cross checked by utilizing data from the two other approaches. Table 24 above shows that social carrying capacities based on contact preference standards were not exceeded at any use level or overall. To verify the accuracy of these social capacity estimates in this case, it is expected that a majority of dissatisfied users indicate reasons other than crowding as their primary reason for dissatisfaction and that perceived crowding is low, or below capacity based on the perceived crowding approach. At Monte Bello, there were only 2 dissatisfied respondents. One user indicated that their dissatisfaction was primarily due to the hot weather, the other was primarily dissatisfied because of the bicyclists sharing the hiking trails. Although neither user related crowding as their primary reason for dissatisfaction, these data are too small to cross check the contact preference standards,

however perceived crowding data can be utilized. As seen in Table 20, perceived crowding is low for the various use levels and overall, ranging from 0% to 21% of respondents reporting some degree of crowding at the various use levels and only 10% of all respondents indicating some degree of crowding. Perceived crowding data are supportive of the determined contact preference standards; social carrying capacity is not currently being exceeded at various use levels or overall at Monte Bello. Because the two approaches are in agreement, social carrying capacity estimates based on the contact preference standard approach will not be adjusted and will be considered the best estimates of social carrying capacity for Monte Bello.

Product Shift

At Monte Bello, the only respondents indicating that they encountered more users than they expected were 12% of the Sunday hikers. Thirteen percent of these hikers reported that they had changed their thoughts about what type of recreational experience was being provided, and hence utilized product shift coping behavior.

Displacement

As mentioned above, 12% of the Sunday hikers were the only respondents to report that they had encountered more users than expected. Regarding future displacement of these respondents, 25% said they would visit a less used preserve next time, 50% indicated that they would return to Monte Bello at a less busy time next visit, and 63% said they would utilize the less used trails on their next visit to the preserve.

Although future user displacement does not appear to be of immediate concern at

Monte Bello, survey respondents indicated high levels of current intersite displacement behavior. Table 25 illustrates current intersite displacement of Monte Bello users from high use preserves to less used preserves like Monte Bello. Fifty-eight percent of all survey respondents reported that they sometimes avoid high use preserves and choose to visit less used preserves and 6% said that they always avoid visiting the high use preserves.

Table 25.--Current Intersite Displacement of Monte Bello Respondents to Lesser Used Preserves

	Percent Reporting That They Have Stopped Using High Use Preserves and Choose to Visit Less Used Preserves	
Day of Week (use level)/ User Group (sample size)	"Always"	"Sometimes"
Tuesday (Low Use)		
Hikers (20)	0%	70%
Bicyclists (21)	10%	62%
Users Combined (41)	4%	67%
Friday (Medium Use)		
Hikers (27)	0%	70%
Bicyclists (26)	0%	27%
Users Combined (53)	0%	52%
Sunday (High Use)		
Hikers (68)	12%	56%
Bicyclists (48)	0%	54%
Users Combined (116)	9%	55%
Combined Days & Users (210)	6%	58%

Temporal displacement of Monte Bello visitors (Table 26) is notable with 28% of Tuesday visitors and 21% of Sunday visitors indicating that they sometimes avoid visiting the preserve during high use times. Overall, 19% of the respondents said they sometimes avoid Monte Bello at high use times and 2% said that they always visit during low use times.

Table 26.--Current Time Displacement of Respondents at Monte Bello

	Percent Reporting That They Have Stopped Using Monte Bello During High Use Times	
Day of Week (use level)/ User Group (sample size)	"Always"	"Sometimes"
Tuesday (Low Use)		
Hikers (20)	0%	40%
Bicyclists (21)	0%	10%
Users Combined (41)	0%	28%
Friday (Medium Use)		
Hikers (27)	0%	7%
Bicyclists (26)	0%	4%
Users Combined (53)	0%	6%
Sunday (High Use)		
Hikers (68)	3%	24%
Bicyclists (48)	2%	13%
Users Combined (116)	3%	21%
Combined Days & Users (210)	2%	19%

Current intrasite displacement of Monte Bello users is not uncommon (Table 27). Sunday users reported the highest percentages of intrasite displacement, with 31% of these hikers and 42% of these bicyclists indicating that they sometimes avoid the more frequently used trails in the preserve. Overall, 24% of all respondents said they sometimes avoid the more frequently used trails and 1% said that they always utilize the less used trails in the preserve.

Table 27.--Current Intrasite Displacement of Respondents at Monte Bello

	Percent Reporting That They Have Stopped Using More Frequently Used Trails at Monte Bello	
Day of Week (use level)/ User Group (sample size)	"Always"	"Sometimes"
Tuesday (Low Use)		
Hikers (20)	0%	15%
Bicyclists (21)	0%	5%
Users Combined (41)	0%	11%
Friday (Medium Use)		
Hikers (27)	4%	15%
Bicyclists (26)	0%	8%
Users Combined (53)	2%	12%
Sunday (High Use)		
Hikers (68)	2%	31%
Bicyclists (48)	0%	42%
Users Combined (116)	1%	34%
Combined Days & Users (210)	1%	24%

Displacement data of Monte Bello users specifically from Rancho San Antonio (Table 28) indicates that 46% of the survey respondents have visited Rancho San Antonio. Of those users who have been to Rancho San Antonio, 55% say that they sometimes choose not to visit the preserve because of its high use levels and 20% reported that they always avoid visiting Rancho San Antonio for this reason.

Table 28.--Current Intersite Displacement of Respondents at Monte Bello From Rancho San Antonio

	Percent Reporting That They Have Visited Rancho San Antonio and Have Stopped Visiting There Because of its High Use Levels		
Day of Week (use level)/ User Group (sample size)	% Who Have Visited RSA	"Always" Avoid RSA	"Sometimes" Avoid RSA
Tuesday (Low Use)			
Hikers (20)	35%	43%	57%
Bicyclists (21)	48%	0%	60%
Users Combined (41)	40%	23%	58%
Friday (Medium Use)			
Hikers (27)	41%	9%	82%
Bicyclists (26)	35%	0%	67%
Users Combined (53)	38%	5%	76%
Sunday (High Use)			
Hikers (68)	54%	24%	43%
Bicyclists (48)	42%	20%	60%
Users Combined (116)	51%	23%	47%
Combined Days & Users (210)	46%	20%	55%

Rancho San Antonio

Shelby and Heberlein's (1986) three prerequisite conditions to estimating social carrying capacity for Rancho San Antonio are presented in Table 29. Use level and encounters per hour correlations demonstrate a significantly positive, low relationship between the two variables for hikers and joggers and a significantly positive, moderate relationship for bicyclists. Nearly 100% of all respondents prefer the open space recreation opportunities as are currently offered. The consensus of users regarding the appropriate number of encounters per visit hour is not as strong as would be desired. Although a consensus of bicyclists and joggers indicated that 40 to 50 encounters per hour would be appropriate for recreating at Rancho San Antonio, less than 50% of the hikers agreed. Therefore, the encounters per hour spread was increased to 30 to 50 to identify the consensus. This range is fairly large, possibly due to different recreational goals between hikers and bicyclists/joggers at Rancho San Antonio. Hikers include solitude as a primary recreational goal more often than bicyclists and joggers who may be focusing more on physical exercise goals. Additionally, bicyclists and joggers generally move faster and travel farther than hikers, hence they encounter more people than hikers and may find a higher number of encounters per hour acceptable and appropriate. Because of these differences between user groups, the encounters per hour consensus condition will be disregarded to allow this study to proceed.

Table 29.--Prerequisite Conditions for Determining Social Carrying Capacity at Rancho San Antonio

User Group	Use Level & Encounters/Hr Correlation[a]	Percent Preferring Open Space Recreation as Current	Encounters/Hr Consensus
Hikers	.32	99%	51% say 30-50 enc/hr
Bicyclists	.40	100%	71% say 30-50 enc/hr
Joggers	.38	100%	67% say 30-50 enc/hr

[a]$p<.001$

Satisfaction

Satisfaction ratings in Table 30 illustrate that a large majority of visitors (70% to 86%) were highly satisfied ("excellent"/"perfect") at all three use levels and less than 1% of all respondents were dissatisfied with their open space experience. Correlation coefficient analysis between use level and satisfaction produced a significantly negative relationship between the two variables, however it is negligible, with use level explaining only about 1% of the variance in satisfaction. The satisfaction model is therefore not supported and carrying capacity can not be estimated using the satisfaction approach alone.

Table 30.--Frequency distribution of satisfaction ratings at Rancho San Antonio for various use levels

Day of Week (use level)/ User Group (sample size)	Percent Rating Satisfaction As: Poor/Fair	Good/ Very Good	Excellent/ Perfect	Use Level-Satisfaction Correlation[a]
Tuesday (Low: 0-1452)				
Hikers (91)	0%	22%	78%	
Bicyclists (28)	0%	22%	78%	
Joggers (93)	0%	14%	86%	
Combined Users (212)	0%	21%	79%	
Friday (Medium: 1453-1546)				
Hikers (95)	0%	19%	81%	
Bicyclists (29)	0%	18%	82%	
Joggers (97)	0%	14%	86%	
Combined Users (221)	0%	18%	82%	
Sunday (High: 1547-3200)				
Hikers (91)	1%	29%	70%	
Bicyclists (54)	2%	18%	80%	
Joggers (95)	0%	14%	86%	
Combined Users (240)	1%	28%	71%	
Combined Days & Users (673)	<1%	22%	78%	-.09

[a] $p<.01$

Satisfaction ratings for various encounter levels are displayed in Table 31. Although sample sizes of hikers and joggers at high encounter levels are not large enough to analyze, all other satisfaction responses indicate that a majority of respondents (70% to 90%) were highly satisfied at all three encounter levels. Correlation coefficient analysis of encounters per hour and satisfaction produced a significantly negative relationship between the two variables, however it is negligible with encounters explaining only 3% of the variance in satisfaction.

Table 31.--Frequency Distribution of Satisfaction Ratings at Rancho San Antonio for Various Encounter Levels

	Percent Rating Satisfaction As			
Encounter Level Per Hr/ User Group (sample size)	Poor/Fair	Good/ Very Good	Excellent/ Perfect	Encounter Level-Satisfaction Correlation[a]
Low (0-85.9)				
Hikers (248)	0%	22%	78%	
Bicyclists (23)	0%	17%	83%	
Joggers (256)	0%	14%	86%	
Medium (86-171.9)				
Hikers (27)	4%	26%	70%	
Bicyclists (59)	0%	27%	73%	
Joggers (28)	0%	11%	89%	
High (172-258)				
Hikers (2)	0%	50%	50%	
Bicyclists (29)	3%	7%	90%	
Joggers (1)	0%	100%	0%	
Combined Encounter Levels & Users (673)	<1%	22%	78%	-.17

[a]$p<.001$

Perceived Crowding

Table 32 presents crowding ratings for the three use levels at Rancho San Antonio. In general, percentages of visitors reporting some degree of crowding rise as use level increases. Forty-three percent of users felt some degree of crowding during low use, 45% reported feeling crowded on medium use days, and 70% said they felt some degree of crowding on the highest use days. Overall, about 53% of the respondents indicated that they felt some degree of crowding during their open space visit. Correlation coefficient analysis of use levels and perceived crowding produced a significantly positive, low relationship between the two variables with use levels explaining about 14% of the variance in crowding.

Table 32.--Frequency distribution of crowding ratings at Rancho San Antonio for various use levels

Day of Week (use level)/ User Group (sample size)	Percent Rating Crowding As: Not At All	Slightly Crowded	Moderately Crowded	Extremely Crowded	Use Level-Crowding Correlation[a]
Tuesday (Low: 0-1452)					
Hikers (91)	51%	30%	19%	0%	
Bicyclists (28)	44%	26%	30%	0%	
Joggers (93)	73%	21%	6%	0%	
Combined Users (212)	57%	28%	15%	0%	
Friday (Medium: 1453-1546)					
Hikers (95)	54%	35%	11%	0%	
Bicyclists (29)	34%	59%	7%	0%	
Joggers (97)	61%	27%	12%	0%	
Combined Users (221)	55%	33%	12%	0%	
Sunday (High: 1547-3200)					
Hikers (91)	30%	24%	43%	3%	
Bicyclists (54)	22%	52%	22%	4%	
Joggers (95)	28%	34%	38%	0%	
Combined Users (240)	30%	25%	42%	3%	
Combined Days & Users (673)	47%	30%	23%	<1%	.38

[a]$p<.001$

The relationship between encounter levels and crowding is slightly stronger than the use level/crowding relationship (Table 33). Correlation analysis between contacts and perceived crowding produced a significantly positive, moderate relationship between the two variables with 19% of the variance in crowding explained by contacts. Although sample sizes of hikers and joggers at high contact levels are not large enough for analysis, all other data indicates perceived crowding increases with higher levels of contact.

Table 33.--Frequency Distribution of Crowding Ratings at Rancho San Antonio for Various Encounter levels

	Percent Rating Crowding As				
Encounter Level Per Hr/ User Group (sample size)	Not At All	Slightly Crowded	Moderately Crowded	Extremely Crowded	Encounter Level-Crowding Correlation[a]
Low (0-85.9)					
Hikers (248)	48%	31%	20%	1%	
Bicyclists (23)	78%	22%	0%	0%	
Joggers (256)	60%	27%	13%	0%	
Medium (86-171.9)					
Hikers (27)	15%	26%	55%	4%	
Bicyclists (59)	29%	56%	14%	1%	
Joggers (28)	0%	29%	71%	0%	
High (172-258)					
Hikers (2)	50%	0%	50%	0%	
Bicyclists (29)	0%	48%	48%	4%	
Joggers (1)	0%	0%	100%	0%	
Combined Encounter Levels & Users (673)	47%	30%	23%	<1%	.44

[a] $p<.001$

The relationship between perceived crowding and satisfaction is presented in Table 34. Correlation coefficient analysis of perceived crowding and satisfaction produced a significantly negative relationship between the two variables, however it is small, with only about 7% of the variance in satisfaction explained by crowding. Overall, more than 99% of the visitors reported being satisfied with their experience regardless of the degree of crowding they felt.

Table 34.--Perceived Crowding and Satisfaction Ratings at Rancho San Antonio

	Percent Rating Satisfaction As			
Crowding Rating/ User Group (sample size)	Poor/Fair	Good/ Very Good	Excellent/ Perfect	Crowding-Satisfaction Correlation[a]
Not at All Crowded				
Hikers (124)	0%	15%	85%	
Bicyclists (34)	0%	21%	79%	
Joggers (155)	0%	12%	88%	
Slightly Crowded				
Hikers (83)	0%	27%	73%	
Bicyclists (52)	0%	21%	79%	
Joggers (77)	0%	16%	84%	
Moderately Crowded				
Hikers (67)	2%	34%	64%	
Bicyclists (23)	0%	13%	87%	
Joggers (53)	0%	19%	81%	
Extremely Crowded				
Hikers (3)	0%	33%	67%	
Bicyclists (2)	50%	50%	0%	
Joggers (0)	-	-	-	
Combined Encounter Levels & Users (673)	<1%	22%	78%	-.27

[a]$p<.001$

Perceived crowding data at Rancho San Antonio indicates that overall, social carrying capacity is not being exceeded, however crowding is very high with 53% of all respondents reporting some degree of crowding. It does appear, however that social capacity is being exceeded on the highest use days where 70% of the respondents indicated some degree of crowding and capacity was exceeded individually for all three user groups. Capacity was not exceeded at any other times except for bicyclists on the medium use Fridays where 66% of the bicycling respondents indicated some degree of crowding.

Based on the perceived crowding approach and the Capacity Judgment Table 2 in Chapter 4 (Shelby et al. 1989) social carrying capacity is being slightly exceeded on the highest use days. For these survey days, the average number of encounters per hour experienced visitors was fifty-nine (see Table 35). Therefore, using the perceived crowding approach, the social carrying capacity of high use Sundays is 59 contacts or less. Because the Capacity Judgment Table 2 is subjective and 70% reported crowding is very close to 65%, social carrying capacity based on this approach will be set at 59 encounters per visit hour.

Contact Preference Standard

Contact preference standards for Rancho San Antonio are presented in Table 35. It should be noted that 26 hiker surveys, 7 bicyclist surveys, and 16 jogger surveys were discarded as unusable based on their lack of transition from a "neutral/pleasant" response to an "unpleasant" response to increasing encounters in survey question 4. Actual

Table 35 .--Contact preference standards (CPS) in encounters per hour at Rancho San Antonio

Day of Week (use level)/ User Group (sample size)	Hiker CPS	Actual Hikers Enc/Hr	Bicyclist CPS	Actual Bicyclists Enc/Hr	Jogger CPS	Actual Joggers Enc/Hr	Total CPS	Actual Total Encounters Experienced/Hr
Tuesday (Low: 0-1452)								
Hikers (91)	52	21	16	1	30	13	98	35
Bicyclists (28)	91	65	105	3	93	51	289	119
Joggers (93)	51	26	29	1	61	16	141	43
Users Combined (212)	52	23	21	1	39	15	112	39
Friday (Medium: 1453-1546)								
Hikers (95)	36	22	14	1	30	11	80	34
Bicyclists (29)	96	65	102	3	90	34	288	102
Joggers (97)	43	26	22	1	51	17	116	44
Users Combined (221)	38	24	17	1	36	13	91	38
Sunday (High: 1547-3200)								
Hikers (91)	35	39	13	2	31	16	79	57
Bicyclists (54)	83	114	80	10	76	37	239	161
Joggers (95)	44	43	23	4	51	18	118	65
Users Combined (240)	36	41	14	2	32	16	82	59
Combined Days & Users (673)	42	29	17	2	34	14	93	45

encounter levels were generally well below the contact preference standards except for the number of Sunday hikers encountered by other users. On these high use days, hikers, bicyclists, and users overall had their hiker contact preference standards exceeded.

Social carrying capacity estimations for the three days of the week and overall using the contact preference standards are summarized in Table 36. Daily capacities and overall capacities are not currently being exceeded based on this approach alone.

Table 36.--Social Carrying Capacities for Each Study Day and Overall at Rancho San Antonio Using the Contact Preference Standard Approach

Day of Week (use level)	Social Carrying Capacity (Enc/Hr)	Actual Encounters/Hr
Tuesday (Low: 0-1452)	112	39
Friday (Medium: 1453-1546)	91	38
Sunday (High: 1547-3200)	82	59
Combined Days	93	45

Social Carrying Capacity Based on Data Synthesis of all Three Approaches

Analysis of Rancho San Antonio data produced significant relationships between perceived crowding and satisfaction and perceived crowding and contacts, therefore social carrying capacity as estimated by the contact preference standard approach can be cross checked by utilizing data from the two other approaches. Table 36 above illustrates that social carrying capacities based on contact preference standards were not exceeded at any use level or overall. To verify the accuracy of these social capacity estimates in this case,

it is expected that a majority of dissatisfied users indicate reasons other than crowding as their primary reason for dissatisfaction and that perceived crowding is low, or below capacity based on the perceived crowding approach. At Rancho San Antonio, there were only two dissatisfied respondents. One user indicated that their dissatisfaction was primarily due to the lack of bicycle trails past the farm area, while the other did indicate crowding as their primary reason for dissatisfaction. Because the sample of dissatisfied users is too small, dissatisfaction data can not be used to cross check the contact preference standards, however perceived crowding data can be utilized. As seen in previously in Table 32, perceived crowding is below capacity overall and for all use levels except the high use Sundays, where 70% of the users reported some degree of crowding. Based on the Capacity Judgment Table 2 in Chapter 4 (Shelby et al. 1989), capacity is surpassed when about 65% of the respondents indicate some degree of crowding. Therefore, using the perceived crowding approach, capacity on high use Sundays is being slightly surpassed. Because reported crowding was high, it is possible that the Sunday respondents overestimated their contact preference standards. The difference in capacity estimation between the two approaches is 23 encounters per hour; the two approaches are definitely not in agreement. Of the 70% of Sunday respondents who indicated feeling some degree of crowding, 36% reported only slight crowding, 60% felt moderately crowded, and 4% said they were extremely crowded. With nearly two-thirds of these responses indicating more than slight crowding on Sundays, it is further supported that the contact preference standard is not accurate. The greater intensity of crowding felt by respondents indicates that the contact level was not tolerable, therefore social capacity for

high use Sunday will be based on the results of the perceived crowding approach and not the contact preference standard. Table 37 presents the social carrying capacities for Rancho San Antonio illustrating this adjustment as well as the recalculation of the overall social capacity based on the change to the Sunday capacity. Although recalculation of overall capacity reduced the estimation by 10 encounters per visit hour, overall social capacity is still not being exceeded.

Table 37.--Social Carrying Capacities for Each Study Day and Overall at Rancho San Antonio

Day of Week (use level)	Social Carrying Capacity (Enc/Hr)	Actual Encounters/Hr
Tuesday (Low: 0-1452)	112	39
Friday (Medium: 1453-1546)	91	38
Sunday (High: 1547-3200)	59	59
Combined Days	83	45

Product Shift

At Rancho San Antonio 14% of all visitors indicated that they had encountered more other visitors than they had expected (Table 38). Of these respondents, 9% reported that they had changed their thoughts about what type of recreational experience was being provided, and hence utilized product shift coping behavior. Visitors encountering more people than expected is highest on high use Sundays where 22% of the respondents reported encountering more other users than expected, and 14% of these users said they

had utilized product shift behavior.

Table 38.--Percentages of Product Shift at Various Use Levels at Rancho San Antonio

	Percent Reporting Product Shift When Encountering More People Than Expected	
Day of Week (use level)/ User Group(sample size)	Percent Who Encountered More Than Expected	Percent Product Shift
Tuesday (Low: 0-1452)		
Hikers (91)	9%	13%
Bicyclists (28)	4%	0%
Joggers (93)	3%	0%
Combined Users (212)	7%	11%
Friday (Medium: 1453-1546)		
Hikers (95)	16%	0%
Bicyclists (29)	4%	0%
Joggers (97)	4%	0%
Combined Users (221)	13%	0%
Sunday (High: 1547-3200)		
Hikers (91)	22%	14%
Bicyclists (54)	9%	20%
Joggers (95)	7%	14%
Combined Users (240)	22%	14%
Combined Days & Users (673)	14%	9%

Displacement

Future displacement data for those respondents indicating that they had encountered more users than they had expected is presented in Table 39. Possible future displacement of these users is greatest for high use Sunday respondents. Overall, for the 14% of respondents reporting that they had encountered more other users than expected, 20% said they will visit a less used preserve next time, 54% will return to Rancho San Antonio at a less busy time next visit, and 49% said they will utilize the less used trails on their next visit to the preserve.

Survey respondents indicated high levels of current displacement. Table 40 illustrates current intersite displacement of Rancho San Antonio users from high use preserves like Rancho to less used preserves like Monte Bello and Los Trancos. Forty-six percent of all respondents said that they sometimes avoid high use preserves and choose to visit less used preserves. Although Rancho San Antonio is probably the highest use preserve in the Open Space District, some respondents stated that they "always" avoid visiting high use preserves. This data, while presented here, is not considered since the users were actually visiting a very high use preserve.

Table 39.--Percentages of future displacement of users at various use levels at Rancho San Antonio

	Percent Reporting Future Displacement When Encountering More People Than Expected			
Day of Week (use level)/ User Group (sample size)	Percent Who Encountered More Than Expected	Percent to Visit Less Used Preserve Next Time	Percent to Visit RSA at Less Busy Time Next Time	Percent to Visit Less Used Trails at RSA Next Time
Tuesday (Low: 0-1452)				
Hikers (91)	9%	25%	63%	25%
Bicyclists (28)	4%	0%	0%	0%
Joggers (93)	3%	0%	0%	0%
Combined Users (212)	7%	22%	54%	22%
Friday (Medium: 1453-1546)				
Hikers (95)	16%	0%	40%	40%
Bicyclists (29)	4%	100%	0%	100%
Joggers (97)	4%	0%	25%	100%
Combined Users (221)	13%	<1%	39%	45%
Sunday (High: 1547-3200)				
Hikers (91)	22%	33%	62%	62%
Bicyclists (54)	9%	40%	80%	0%
Joggers (95)	7%	14%	86%	86%
Combined Users (240)	22%	33%	62%	62%
Combined Days & Users (673)	14%	20%	54%	49%

Table 40.--Current intersite displacement of Rancho San Antonio respondents to lesser used preserves

	Percent Reporting That They Have Stopped Using High Use Preserves and Choose to Visit Less Used Preserves	
Day of Week (use level)/ User Group (sample size)	"Always"	"Sometimes"
Tuesday (Low Use)		
Hikers (91)	6%	40%
Bicyclists (28)	0%	11%
Joggers (93)	0%	14%
Users Combined (212)	4%	32%
Friday (Medium Use)		
Hikers (95)	6%	52%
Bicyclists (29)	0%	14%
Joggers (97)	1%	12%
Combined Users (221)	5%	42%
Sunday (High Use)		
Hikers (91)	4%	60%
Bicyclists (54)	0%	19%
Joggers (95)	1%	30%
Combined Users (240)	4%	58%
Combined Days & Users (673)	5%	46%

Temporal displacement of Rancho San Antonio visitors (Table 41) is considerable with 56% of all respondents indicating that they sometimes avoid visiting the preserve during high use times and 13% saying they always visit during low use times. Although "high use times" may refer to days or times of day, temporal displacement percentages are higher for low and medium use days illustrating displacement of users from high use Sundays to the less used days of the week.

Table 41.--Current Time Displacement of Respondents at Rancho San Antonio

	Percent Reporting That They Have Stopped Using RSA During High Use Times	
Day of Week (use level)/ User Group (sample size)	"Always"	"Sometimes"
Tuesday (Low Use)		
Hikers (91)	17%	54%
Bicyclists (28)	0%	67%
Joggers (93)	6%	69%
Users Combined (212)	13%	58%
Friday (Medium Use)		
Hikers (95)	20%	55%
Bicyclists (29)	4%	68%
Joggers (97)	7%	72%
Combined Users (221)	17%	59%
Sunday (High Use)		
Hikers (91)	8%	53%
Bicyclists (54)	0%	69%
Joggers (95)	4%	75%
Combined Users (240)	7%	54%
Combined Days & Users (673)	13%	56%

Current intrasite displacement of Rancho San Antonio users is common (Table 42). More than half of Friday and Sunday users reported sometimes avoiding the more frequently used trails in the preserves, while 4% said they always utilize the less used trails. Overall, 46% of all respondents indicated that they sometimes avoid the more frequently used trails and 6% said that they always utilize the less used trails.

Table 42.--Current Intrasite Displacement of Respondents at Rancho San Antonio

	Percent Reporting That They Have Stopped Using More Frequently Used Trails at Rancho San Antonio	
Day of Week (use level)/ User Group (sample size)	"Always"	"Sometimes"
Tuesday (Low Use)		
Hikers (91)	12%	29%
Bicyclists (28)	0%	4%
Joggers (93)	2%	57%
Users Combined (212)	9%	36%
Friday (Medium Use)		
Hikers (95)	4%	54%
Bicyclists (29)	0%	18%
Joggers (97)	4%	53%
Combined Users (221)	4%	53%
Sunday (High Use)		
Hikers (91)	2%	52%
Bicyclists (54)	0%	26%
Joggers (95)	2%	65%
Combined Users (240)	2%	52%
Combined Days & Users (673)	6%	46%

CHAPTER VI

DISCUSSION OF RESULTS

Failure of the Satisfaction Approach

Based on previous social capacity studies, it is not unexpected that the satisfaction approach alone was not a useful tool in estimating social carrying capacity in this study. Satisfaction is a complex psychological phenomenon that is affected by a multitude of factors. The number of people in a given area or the number of contacts with others is only one of many things that might influence a person's recreational satisfaction. People set experience goals and expectations to obtain satisfaction from a variety of inputs such as being close to nature, getting exercise, experiencing solitude, etc. As a result, experience satisfaction may be high even in a high density recreational area where contacts with other users is frequent. Conversely, a recreationist can have a very unsatisfying experience with minimal contacts if the weather is unfavorable, if trails are littered, or they are stung by an insect (Shelby and Heberlein 1986).

In addition to experience goals/expectations, there are other possible reasons that contribute to explaining the lack of a relationship between satisfaction and use/encounter levels. The "self selection" theory relates to a person's freedom of recreation choice. Although people may do things they do not enjoy in everyday life, they generally choose recreational activities that they will enjoy while avoiding those that they will not. This

being the case, most recreationists will have satisfying experiences regardless of use/encounter levels because they have selected an experience that they will enjoy. Product shift coping behavior also contributes to maintaining experience satisfaction when encounter levels are excessive. Recreationists who encounter more users than they had expected re-think their expectations of the recreational experience, or "product," being provided. Redefining the recreational experience to equate with the encounter levels experienced allows the person to see the area in a more realistic light while maintaining their satisfaction. Displacement theory states that dissatisfied users may leave a particular high use area in search of a lower density experience. These displaced recreationists are then replaced at the high use area by users who are less sensitive to a greater number of contacts. A final explanation for the failure of the satisfaction model involves user rationalization. In general, recreationists desire to have fun, and regardless of the situation, most people will try to make the best out of even an unpleasant situation. Focusing on the positive aspects of the experience and minimizing the negative ones allows the recreationist have a satisfying experience even if it wasn't perfect (Manning and Ciali 1980, Manning 1986, Shelby and Heberlein 1986).

Integration of the Three Approaches to Determine Social Carrying Capacity

The methodology of this study utilized an integration of the results of all three social carrying capacity approaches to produce a richer measure of capacity at the three open space preserves, whereas previous studies have often utilized data from a single approach. Although the contact preference standard approach is the most direct method to determine

social carrying capacity in terms of social impact, satisfaction and perceived crowding data collected here provided further insight into user characteristics and social capacities. The perceived crowding data was successfully used to verify the social capacity estimations of the contact preference standard approach. Future social capacity studies should employ this more comprehensive approach to cross check their data as well as to form a more detailed analysis of user characteristics. As the methodology used in this study was developed from previous social capacity research for various recreational settings, this integrative approach can be utilized not only for other open space preserve studies, but for all other recreational situations from canoeing to back country hiking to fly fishing.

Social Carrying Capacity Estimations and Exceedance

Los Trancos

Los Trancos data analysis results indicate that there is no current threat to social carrying capacity exceedance overall or for the various days of the week studied (Tuesday, Friday, Sunday). At an overall average of five contacts per hour, Los Trancos visitors enjoy the lowest average number of encounters with other users between the three preserves studied. Overall social carrying capacity is estimated at 41 contacts per hour which is well above the 5 encounters per hour currently being experienced. Reported crowding is low, with only 10% of all respondents reporting any degree of crowding. Even on high use Sundays, 79% of the respondents indicated that they did not feel crowded. User satisfaction is not unexpectedly high at Los Trancos, with 79% of all

respondents reporting an excellent or perfect experience. There were no respondents who reported a dissatisfying visit to the preserve.

Monte Bello

Similar to Los Trancos, data analysis results of Monte Bello indicate that there is no current threat to exceeding overall or daily social carrying capacity at this preserve. Overall, Monte Bello users experience an average of 6 encounters per hour which is well below the estimated social capacity of 43 contacts per hour. Only 10% of all respondents indicated any feelings of crowding, and 79% of high use Sunday respondents stated that they did not feel crowded. Monte Bello user satisfaction is very high with 87% of all respondents reporting excellent or perfect experiences. Reports of dissatisfying experiences were limited to 3% of the Sunday hiker sample, and their dissatisfaction was not a result of feeling crowded.

Rancho San Antonio

Overall, Rancho San Antonio visitors experience an average of 45 contacts per hour which, although high, is below the estimated overall social capacity of 83 encounters per hour. However, social carrying capacity on high use Sundays, estimated at 59 encounters per hour, is currently being reached. Perceived crowding on Sundays is quite high with 70% of these respondents indicating they felt some degree of crowding. Overall, 53% of the respondents reported some degree of crowding which is a concern based on the carrying capacity judgment guidelines in Table 2 from Shelby et al. (1989) that indicate capacity is being neared. Overall user satisfaction is high with 78% of respondents

indicating excellent or perfect open space experiences. Although 99% of all Sunday respondents were satisfied with their experience, only 71% reported excellent or perfect days. Less than 1% of all respondents were dissatisfied with their experience.

Daily Variances in Social Carrying Capacities

For each of the three preserves studied, estimated social capacities of low use Tuesdays were the highest, while capacities of high use Sundays were the lowest. It is possible that visitors on low use days, encountering fewer people than on busy weekends, overestimate their contact tolerance level. Another explanation may be that different kinds of people with different experience goals and expectations visit at different times of the week. Weekends are seen as a "getaway" time; people who have worked all week look forward to escaping the city and its people. Many weekend visitors may be more sensitive to excessive contacts and place more importance on solitude than weekday visitors.

Psychological Coping Behaviors and Differences in Social Carrying Capacities

In areas where use/encounter levels are rising, it has been found that users often change their perceptions of the type of recreational experience being offered or become displaced from the area rather than simply becoming dissatisfied with their experiences (Shelby et al. 1988). These product shift and displacement coping behaviors preserve a recreationist's satisfaction and can lead to increases in the social carrying capacity of a particular area. When visitors utilize product shift, they change their definition of the recreational experience and hence, psychologically adapt to the higher use/encounter levels. Visitors adapting to and tolerating the higher contact levels at one preserve can

cause social capacity to rise and become higher than at other preserves where there is no evidence of product shift behavior. When density sensitive users are displaced from an area, they are generally replaced by less encounter sensitive users. The replacing of density sensitive users with those more tolerant of frequent encounters can also contribute to rising social carrying capacity. Reports of visitors being displaced from a particular area can offer insight into the differences in capacity between various sites.

Los Trancos, the preserve with the lowest overall use levels in this study, also has the lowest overall social carrying capacity, estimated at 41 contacts per hour. Monte Bello, whose overall use levels are somewhat higher than Los Trancos, has an overall social carrying capacity slightly higher than Los Trancos, estimated at 43 contacts per hour. Rancho San Antonio, having much higher overall use levels than Los Trancos and Monte Bello, has the highest overall social carrying capacity, estimated at 83 contacts per hour. The utilization of psychological coping behaviors by preserve users can help to explain these differences in capacity.

Los Trancos

Los Trancos data indicates that product shift and future displacement coping behaviors are virtually non-existent at this time. Visitors appear to be comfortable with the current use/encounter levels at this preserve and do not feel they need to change their experience definitions or that they must seek out less used preserves, less used trails at Los Trancos, or visit at less busy times. Temporal and intrasite displacement at Los Trancos are not significant, however, current intersite displacement is notable, with 40%

of all respondents indicating that they "sometimes," and 5% saying that they "always," avoid visiting high use preserves and choose to visit less used preserves such as Los Trancos. Specific displacement of Los Trancos visitors from Rancho San Antonio is noteworthy. Overall, 35% of respondents at Los Trancos have visited Rancho San Antonio. Of these users, 61% reported that they "sometimes," and 17% said that they "always," avoid visiting Rancho San Antonio because of its high use levels.

Monte Bello

Product shift and future displacement coping behavior utilization at Monte Bello, although reported by a few users, is not significant at this time. This illustrates that, in general, visitors are comfortable with the current use/encounter levels at this preserve. A small percentage of respondents indicated current temporal and intrasite displacement. Nineteen percent of all respondents reported that they "sometimes," and 2% said that they "always," avoid visiting Monte Bello at high use times. Twenty-four percent of all respondents stated that they "sometimes" avoid the more frequently used trails, while only 1% indicated that they "always" utilize the less used trails. Therefore, a small number of visitors have adjusted to use/encounter levels that cause them to feel crowded by becoming temporally or intrasite displaced in order to maintain their preserve experience satisfaction. It is possible that some of these visitors have been replaced by less density sensitive users during higher use times or on the more frequently used trails. This replacement may partially explain the slightly higher social carrying capacity at Monte Bello versus the capacity at Los Trancos. Current intersite displacement at Monte Bello is

significant and slightly higher than reported at Los Trancos. Fifty-eight percent of all Monte Bello respondents reported that they "sometimes," and 6% said that they "always," avoid high use preserves and choose to visit less used preserves. Specific displacement of Monte Bello visitors from Rancho San Antonio is substantial. Overall, 46% of respondents stated that they have visited Rancho San Antonio, and 55% of these users reported that they "sometimes," and 20% said that they "always," avoid visiting Rancho San Antonio because of its high use levels.

Rancho San Antonio

Although not significant, utilization of product shift coping behavior at Rancho San Antonio was indicated by a small group of users. Fourteen percent of all Rancho respondents indicated that they had encountered more people than they had expected and of these visitors, 9% reported that they had changed their thoughts about what type of recreational experience was being provided. Highest reports of product shift occurred on Sunday, where 22% of respondents stated that they had encountered more people than expected and 14% of these visitors said that they had utilized product shift behavior. Future displacement of respondents who encountered more users than expected is notable. Of the 14% of all respondents who said that they encountered more users than expected, 20% of these visitors will visit a less used preserve during their next open space outing, 54% will visit Rancho at a less busy time, and 49% will utilize the less used trails at Rancho during their next visit. Current intersite displacement of Rancho visitors is pronounced, with 46% of all respondents reporting that they "sometimes" avoid high use

preserves, like Rancho San Antonio, and choose to visit less used preserves. Current temporal displacement indicates that 56% of all respondents "sometimes," and 13% "always," avoid visiting Rancho during high use times. Current intrasite displacement is similarly common, with 46% of all respondents reporting that they "sometimes," and 6% stating that they "always," avoid the more frequently used trails at the preserve. In order to help maintain satisfying open space experiences, many Rancho users are utilizing future and current displacement coping behaviors. It is likely that a significant number of these displaced visitors are being replaced by less density sensitive users and that this phenomenon is a strong contributor to Rancho San Antonio's higher social carrying capacity when compared to Los Trancos and Monte Bello. Evidence of direct displacement of Los Trancos and Monte Bello users from Rancho San Antonio described above further supports this theory.

CHAPTER VII

CONCLUSIONS AND RECOMMENDATIONS

Conclusions

The specific objectives of this study, as discussed in Chapter I, were achieved. Implementation of the preserve user survey generated the data necessary to determine social carrying capacity for each preserve as well as provided information on user characteristics. Utilizing a comprehensive approach that considered the combined results of all three approaches used to estimate social carrying capacity, social capacities for each preserve were estimated and discussed. Differences in social capacity between the three preserves were analyzed by investigating the presence of psychological coping behaviors among users.

Because Rancho San Antonio preserve visitors frequently utilize the various types of displacement coping behavior, it is expected that social carrying capacity will continue to rise as density sensitive users are gradually replaced by less density sensitive visitors. Data from this study indicate that many Los Trancos and Monte Bello users are being displaced from Rancho San Antonio primarily because of its higher use levels. As these and other displaced recreationists seek out less used preserves, social capacity at the less used preserves is also likely to increase over time. Although social impacts (contacts) cannot and should not be eliminated at preserves, management goals should involve

controlling impacts within acceptable limits (social carrying capacity) by manipulating the factors that influence impacts in order to contribute to maximum visitor satisfaction (Hammitt and Cole 1987). The following sections discuss management actions that can be used to aid in controlling escalating use levels, alleviate current congestion at high use preserves or high use areas within a preserve, and better disperse visitors to all preserves.

Management Strategies

Midpeninsula Regional Open Space District's primary management actions are focused on protecting natural habitat while allowing free public access for recreational enjoyment and educational opportunity. Management actions to maintain visitor satisfaction should not conflict with any of the primary objectives of the District, and therefore use level limitations to assist in reducing social impact are not an acceptable solution. In fact, use limitations are only justifiable in areas where demand is so great that a thorough analysis of management options indicates that there is little alternative to implementing use restrictions in order to avoid unacceptable impact levels (Hammitt and Cole 1987). During survey distribution for this study, at least 27 respondents at Rancho San Antonio voluntarily voiced their concerns regarding use restrictions. Although these visitors indicated that they did feel crowded at the preserve, they were not in favor of restricting use.

Recommendations

Dispersal of Use

Because preserve use levels are not expected to decline and restricting use is an inappropriate management technique, reducing social impacts is optimally addressed through dispersal of use. Use dispersion is an indirect, non-confrontational management strategy that promotes a voluntary redistribution of recreational use over an area (Jubenville et al. 1987). By providing specific information to recreationists, such as points of heaviest congestion or existing patterns of use, managers can influence the distribution of people over an area. Voluntary dispersion contributes minimal disruption to normal visitor recreation patterns. Visitors will not feel forced to alter their goals or plans, yet they may find other trails or preserves equally or more enjoyable once they are provided with the necessary information. Ideally, the information should reach recreationists while they are in the "planning stage" of visiting a preserve so that they can make the best choice to meet their recreational goals and expectations. Many studies have tested the effectiveness of information distribution in contributing to voluntary use dispersion. Lime and Lucas (1977) provided recreationists with information on current use patterns in heavily used wilderness areas prior to their visit and found that this information did contribute to influencing the users' choice of entry points, routes, and visitation timing. A study of Yellowstone National Park hikers by Krumpe and Brown (1982) found that 37% of the sample of hikers who were given a brochure promoting the attributes of the Park's less used trails selected one of these trails described in the information while only 14% of a

control group that was not educated on the less used trails chose a route along these trails. Providing more information on available recreation opportunities allows users more variety once they are made aware of the options. Jubenville et al. (1987) outline three general dispersion techniques that focus on information distribution and planning: (1) regional/area planning, (2) regional information management, and (3) area information.

Regional and area planning

Regionally, use patterns are primarily influenced by transportation systems such as access roads and hiking trails. The character and location of these systems often determine the amount and type of use a particular area will incur. Depending on the type and character of roads, access points, and trails, recreational use and patterns of use can be encouraged or discouraged. Preserve planning and improvement should focus on encouraging well-dispersed use through positive means such as easily accessible, multiple access points and varied types of trails. Where possible, existing space should be optimized such that access points and trails are dispersed throughout a preserve rather than a majority being positioned together in one half of the preserve. By-pass trails around popular sites within a preserve should be built where feasible. Tertiary preserve entrances along roads should have some limited parking when at all possible to encourage their use.

Los Trancos. Los Trancos (Figure 9) has a very diverse and spread out trail system. Trails are designated as hiking only, hiking and bicycling only, or hiking, bicycling, and equestrian, and offer both easy and challenging opportunities. In addition to

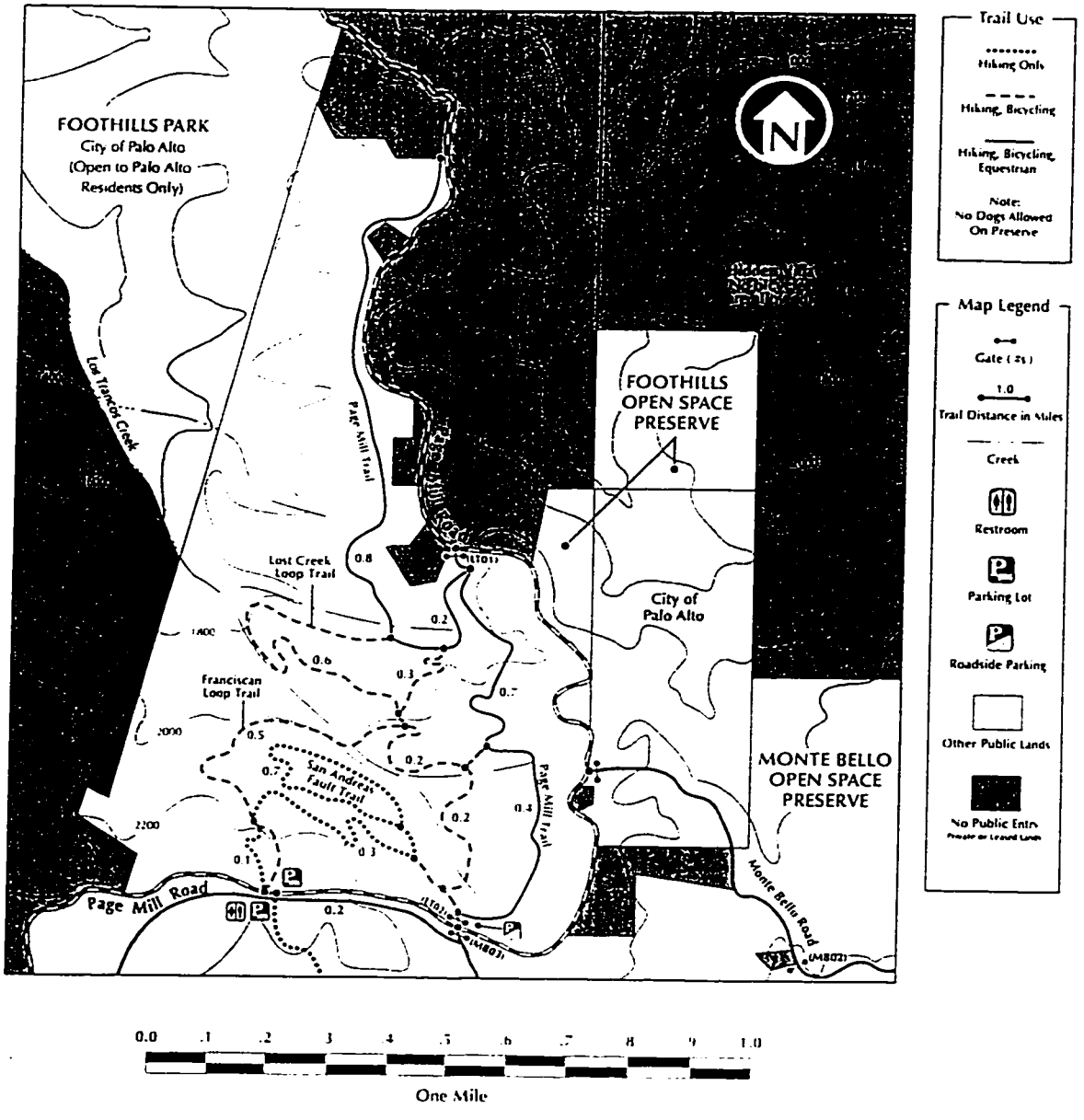

Fig. 9. Los Trancos Open Space Preserve map

Source: Midpeninsula Regional Open Space District 1994.

the main entrance, there are three other direct access points dispersed along Page Mill Road, although only one has roadside parking. Heavy main entrance usage could be lightened somewhat if roadside parking were allowed at the LT01 access point.

Monte Bello. Monte Bello's trails are primarily situated in the northern half of the preserve (Figure 10, see appendix), however these trails do provide many links to other neighboring preserves. Trails are designated as hiking only or hiking, bicycling, and equestrian, and range from flat and easily hiked paths to narrow, single tracks that attract numerous mountain bicyclists looking for an uphill challenge. Although there are three directional choices off of the main entrance parking lot to enter the preserve trail system, visitors often choose the trailhead that leads to the Stevens Creek Nature Trail. Preserve maps and information are located at this trailhead; a natural draw for visitors. The Stevens Creek Nature Trail is also a very popular route as it takes the visitor through diverse ecosystems, and wildlife are frequently visible. Because of these factors, this entrance trail and the two trails it branches into, the Stevens Creek Nature Trail and the Canyon Trail, are frequently congested areas during high use times. Many visitors are unaware of the alternative entrance trails that branch off from the main lot. More effective signage should be placed at these points to better inform users of their options. Posts with leaflet holders can also be placed at these two points.

Monte Bello has six tertiary entrances that provide direct access into the preserve from Page Mill Road, Skyline Boulevard, and Monte Bello Road. Unfortunately, roadside parking is only allowed at one of these entrances, although users can park in the Skyline

Ridge Preserve parking lot to enter Monte Bello via the Skid Road Trail entrance. Providing some roadside parking at a few of Monte Bello's tertiary entrances would certainly encourage the use of these more remote entry points and allow more density sensitive users an alternative to the main entrance parking lot and its immediate trail congestion.

Rancho San Antonio. A majority of Rancho's extensive trail system is situated in the eastern two-thirds of the preserve (Figure 11, see appendix) and leads visitors through a variety of terrain ranging from flat, oak-shaded forests to open and hilly grasslands. Trails are designated as hiking only, hiking and equestrian, and hiking and bicycling. There are two main points of entry into the preserve from Rancho San Antonio County Park. The nearly parallel trails located in the northeastern section of the preserve, leading up to the popular Deer Hollow Farm, are the more commonly used access trails between the two main entry points. Because of the popularity of the farm site and the flat, easy trails/roads that lead visitors there, this section of the preserve is often heavily congested. For those users wishing to enter the preserve through these access trails, but not desiring to pass the farm, two by-pass trails are situated just about 0.2 miles before reaching the farm. Ideally, a by-pass trail should be built at the northeastern entry point, immediately splitting off from these parallel trails, to take the more density sensitive users completely away from the farm route and link them to the Rogue Valley Trail. Once past the farm zone, Rancho users are well-dispersed; the trails offer a variety of route options and loops.

Because of its shape and location, Rancho San Antonio has only two other access

points in addition to the two main entrances. One access point is from Monte Bello Road (no vehicles) leading from Monte Bello Preserve and the other is the Rhus Ridge Trailhead at Rhus Ridge Road in the extreme northwestern section of the preserve. Limited parking for about five vehicles is available at this trailhead, however the addition of more spaces would promote further usage of this remote entrance by visitors attempting to avoid the main entrance crowds.

Parking.

Preserve use levels are not infinite, and perhaps the primary limiting factor to preserve visitation is available parking. Amount and placement of parking areas also directly affect where user congestion will occur. Each preserve in this study has at least one parking lot; Rancho San Antonio has five linked lots that hold about 327 vehicles, serving both Rancho San Antonio County Park and access to the two main preserve entrances; Monte Bello has a main entrance lot that holds about 45 cars; and Los Trancos has a small main entrance lot capable of holding about 20 vehicles. While Rancho San Antonio parking facilities should not be removed in any capacity, no new additional lots should be built around the main entrances. A tertiary entrance to the remote northern section of Rancho San Antonio located along Rhus Ridge Road has a five car parking area. The addition of fifteen spaces to this area would assist in promoting this underused section of the preserve and offer more density sensitive users the opportunity to continue to enjoy the environment that Rancho San Antonio has to offer. Parking at Monte Bello and Los Trancos is ideal for maintaining lower preserve use levels. In addition to the main

entrance parking areas at these two preserves, roadside parking is allowed at a few tertiary entrances and access points along Page Mill Road and Skyline Boulevard which promotes voluntary use of these less used entrances. Monte Bello visitors may also park at the Skyline Ridge Preserve lot to enter Monte Bello via the less used Skid Road Trail. While parking and preserve entrance options are better dispersed around Monte Bello and Los Trancos than at Rancho San Antonio, publicizing the alternate parking zones with roadside signage would inform those users who are not yet aware that roadside parking is legal at these access points. Although preserve trail leaflets illustrate roadside parking areas, signage would reach even more preserve visitors and promote usage of these zones by recreationists seeking access to more remote areas.

Regional information management

Once a preserve has been developed, an information system that reaches visitors before they arrive at their destination is the most effective method for obtaining voluntary use dispersal. Currently, Midpeninsula Regional Open Space District prints the Open Space News, a quarterly newsletter containing general information, a schedule of docent-lead hikes for the season, and an occasional preserve highlight article. Newsletters are available at the District office and are sent to mailing list members and interested parties. Newsletter articles and information could focus more on promoting the attributes of the District's less used preserves and the less used trails of more frequently visited preserves. Directions to remote access points and parking availability should accompany these articles. The District also has an internet site providing a wealth of information on

preserves where these descriptions of less used preserves and trails could be presented. At this time, docent-lead hikes offer outstanding opportunities to explore both low and high use preserves. Hikes are described in the newsletter so visitors can choose the ones that best match their interests.

Area information

On-site information distribution is another way to encourage dispersal of visitor use. Direct visitor contact through signage, leaflets, and preserve rangers can promote a redistribution of use patterns. Main entrances to Midpeninsula preserves have large map cases containing preserve maps, hiking information, and other educational material. Leaflets containing a preserve map and information are available at most preserves at these cases and from the District office. Use description maps could be developed for display in these cases and within the trail leaflet that would indicate the level of use generally experienced along the preserve's various trails. For example, trails coded "A" could designate the high use trails, "B" would indicate a moderately used trail, and "C" would describe the least used trails. Visitors could then be directed to the areas that best suit their encounter tolerances. The newsletter discussed above should also contain these use description maps when highlighting a particular preserve.

The Importance of Monitoring in Preserve Management

In order to determine if management objectives are being achieved, a monitoring program that allows for the evaluation and strengthening of management actions must be developed. To determine the quality of visitor experiences, managers must monitor

experiential conditions. Although this study focuses on social carrying capacity and its role in maintaining quality recreational experiences, it should be remembered that experiential conditions are not limited to the number of contacts users have with others. A well-planned management program monitors other pertinent factors that affect visitor experience satisfaction in addition to encounter/use levels, such as physical challenge and opportunities to experience a relatively unmodified environment. These other indicators of experience satisfaction depend on the type of conditions desired by preserve users. To determine these desired conditions, managers must evaluate what draws visitors to the preserves, such as solitude, being close to nature, and exercise, and choose the most appropriate indicators to monitor. In practicality, only a handful of the most important components to the experience should be attempted to be monitored; information is costly to obtain (Merigliano 1989). Monitoring the significant indicators to visitor experience satisfaction as well as the preserve encounter and use levels while implementing a use dispersal program will ensure the maintenance of visitor experience quality even as use levels rise in the future.

SELECTED REFERENCES

Backstrom, Charles H. and Gerald Hursh-Cesar. 1981. Survey research. 2d. ed. New York: John Wiley & Sons.

Becker, R. H. 1981. Displacement of recreational users between the lower St. Croix and upper Mississippi rivers. Journal of Environmental Management. 13: 259-267.

Graefe, Alan R., Jerry J. Vaske, and Fred R. Kuss. 1984. Social carrying capacity: An integration and synthesis of twenty years of research. Leisure Sciences. 6 (4): 395-431.

Hammitt, William E. and David N. Cole. 1987. Wildland recreation: Ecology and management. New York: John Wiley and Sons.

Hammitt, William E. and Michael E. Patterson. 1991. Coping behavior to avoid visitor encounters: Its relationship to wildland privacy. Journal of Leisure Research. 23 (3): 225-237.

Heberlein, Thomas and Bo Shelby. 1977. Carrying capacity, values, and the satisfaction model: A reply to Greist. Journal of Leisure Research. 9 (2): 142-146.

Hendee, John C., George H. Stankey, and Robert C. Lucas. 1990. Wilderness management. Golden, Colorado: North American Press.

Jubenville, Alan, Ben W. Twight, and Robert H. Becker. 1987. Outdoor recreation management: Theory and application. State College, Pennsylvania: Venture Publishing, Inc.

Krumpe, E. E. and P. J. Brown. 1982. Redistributing backcountry use through information related to recreational experiences. Journal of Forestry. 80 (6): 360-362.

Kuentzel, Walter F. and Thomas A. Heberlein. 1992. Cognitive and behavioral adaptations to perceived crowding: A panel study of coping and displacement. Journal of Leisure Research. 24 (4): 377-393.

Lime, D. W. and R. C. Lucas. 1977. Good information improves the wilderness experience. Naturalist. 28 (4): 18-20.

Manning, Robert E. and Charles P. Ciali. 1980. Recreation density and user satisfaction: A further exploration of the satisfaction model. Journal of Leisure Research. 12 (4): 329-344.

Manning, Robert E. 1986. Studies in outdoor recreation: Search and research for satisfaction. Corvallis, Oregon: Oregon State University Press.

Merigliano, Linda L. 1990. Indicators to monitor the wilderness recreation experience. In Managing America's enduring wilderness resource: Proceedings of the conference in Minneapolis, Minnesota, September 11-17, 1989, edited by David W. Lime, 156-162. St. Paul, Minnesota: University of Minnesota.

Midpeninsula Regional Open Space District. 1980. Basic policy of the Midpeninsula Regional Open Space District. Informational pamphlet.

Midpeninsula Regional Open Space District. 1994. Los Trancos Open Space Preserve. Preserve map.

Midpeninsula Regional Open Space District. 1995. Welcome to regional open space. District map and information sheet.

Midpeninsula Regional Open Space District. 1996a. Escape to your open space. District preserve map.

Midpeninsula Regional Open Space District. 1996b. Los Trancos Open Space Preserve. Trail leaflet.

Midpeninsula Regional Open Space District. 1996c. Monte Bello Open Space Preserve. Trail leaflet.

Midpeninsula Regional Open Space District. 1996d. Rancho San Antonio Open Space Preserve. Trail leaflet.

Midpeninsula Regional Open Space District. 1997a. Monte Bello Open Space Preserve. Preserve map.

Midpeninsula Regional Open Space District. 1997b. Rancho San Antonio Open Space Preserve. Preserve map.

Moore, Steven D. and Stanley K. Brickler. 1987. A planning approach to social carrying capacity research for Aravaipa Canyon Wilderness, Arizona. In Social science in natural resource management dystems ed. Marc L. Miller, Richard P. Gale, and Perry J. Brown, 167-180. Boulder, Colorado: Westview Press.

Pigram, John. 1983. Outdoor recreation and resource management. New York: St. Martin's Press, Inc.

Schreyer, Richard and Joseph W. Roggenbuck. 1978. The influence of experience expectations on crowding perceptions and social-psychological carrying capacities. Leisure Sciences. 1 (4): 373-394.

Shelby, Bo. 1981. Encounter norms in backcountry settings: Studies of three rivers. Journal of Leisure Research. 13 (2): 129-138.

Shelby, Bo and Rick Colvin. 1982. Encounter measures in carrying capacity research: actual, reported, and diary contacts. Journal of Leisure Research. 14 (4): 350-360.

Shelby, Bo, Thomas A. Heberlein, Jerry J. Vaske, and Geraldine Alfano. 1983. Expectations, preferences, and feeling crowded in recreation activities. Leisure Sciences. 6 (1): 1-14.

Shelby, Bo and Thomas A. Heberlein. 1984. A conceptual framework for carrying capacity determination. Leisure Sciences. 6 (4): 433-451.

Shelby, Bo and Thomas A. Heberlein. 1986. Carrying capacity in recreational settings. Corvallis, Oregon: Oregon State University Press.

Shelby, Bo, N. Stewart Bregenzer, and Rebecca Johnson. 1988. Displacement and product shift: empirical evidence from Oregon rivers. Journal of Leisure Research. 20 (4): 274-288.

Shelby, Bo, Jerry J. Vaske, and Thomas A. Heberlein. 1989. Comparative analysis of crowding in multiple locations: Results from fifteen years of research. Leisure Sciences. 11: 269-291.

Stankey, George H., Robert C. Lucas, and David W. Lime. 1976. Crowding in parks and wilderness. Design and Environment. 7 (3): 38-41.

Stankey, George H. and Stephen F. McCool. 1984. Carrying capacity in recreational settings: Evolution, appraisal, and application. Leisure Sciences. 6 (4): 453-472.

Wager, J. Alan. 1964. The carrying capacity of wildlands for recreation. Forest Service Monograph 7. Washington, D.C.: Society of American Foresters.

Wilkinson, Todd. 1995. Crowd control. National Parks, July/August, 36.

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TO: Carol Borck
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FROM: Serena W. Stanford *Serena W. Stanford*
AAVP, Graduate Studies & Research

DATE: March 24, 1997

The Human Subjects-Institutional Review Board has approved your request to use human subjects in the study entitled:

"A Comparative Analysis of Social Carrying Capacity at Three Open Space Preserves"

This approval is contingent upon the subjects participating in your research project being appropriately protected from risk. This includes the protection of the anonymity of the subjects' identity when they participate in your research project, and with regard to any and all data that may be collected from the subjects. The Board's approval includes continued monitoring of your research by the Board to assure that the subjects are being adequately and properly protected from such risks. If at any time a subject becomes injured or complains of injury, you must notify Serena Stanford, Ph.D., immediately. Injury includes but is not limited to bodily harm, psychological trauma and release of potentially damaging personal information.

Please also be advised that all subjects need to be fully informed and aware that their participation in your research project is voluntary, and that he or she may withdraw from the project at any time. Further, a subject's participation, refusal to participate, or withdrawal will not affect any services the subject is receiving or will receive at the institution in which the research is being conducted.

If you have any questions, please contact me at (408) 924-2480.

APPENDIX

Legend

Gate (#s)

1.0 Trail Distance in Miles

Vehicle Driveway

Creek

Bay Area Ridge Trail

Parking Lot

Roadside Parking

Equestrian Parking

Handicapped Parking Only

Restrooms

Trail Use

Hiking Only

Hiking, Equestrian

Note:
Dogs are not allowed on the

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One Mile

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Open Space Preser

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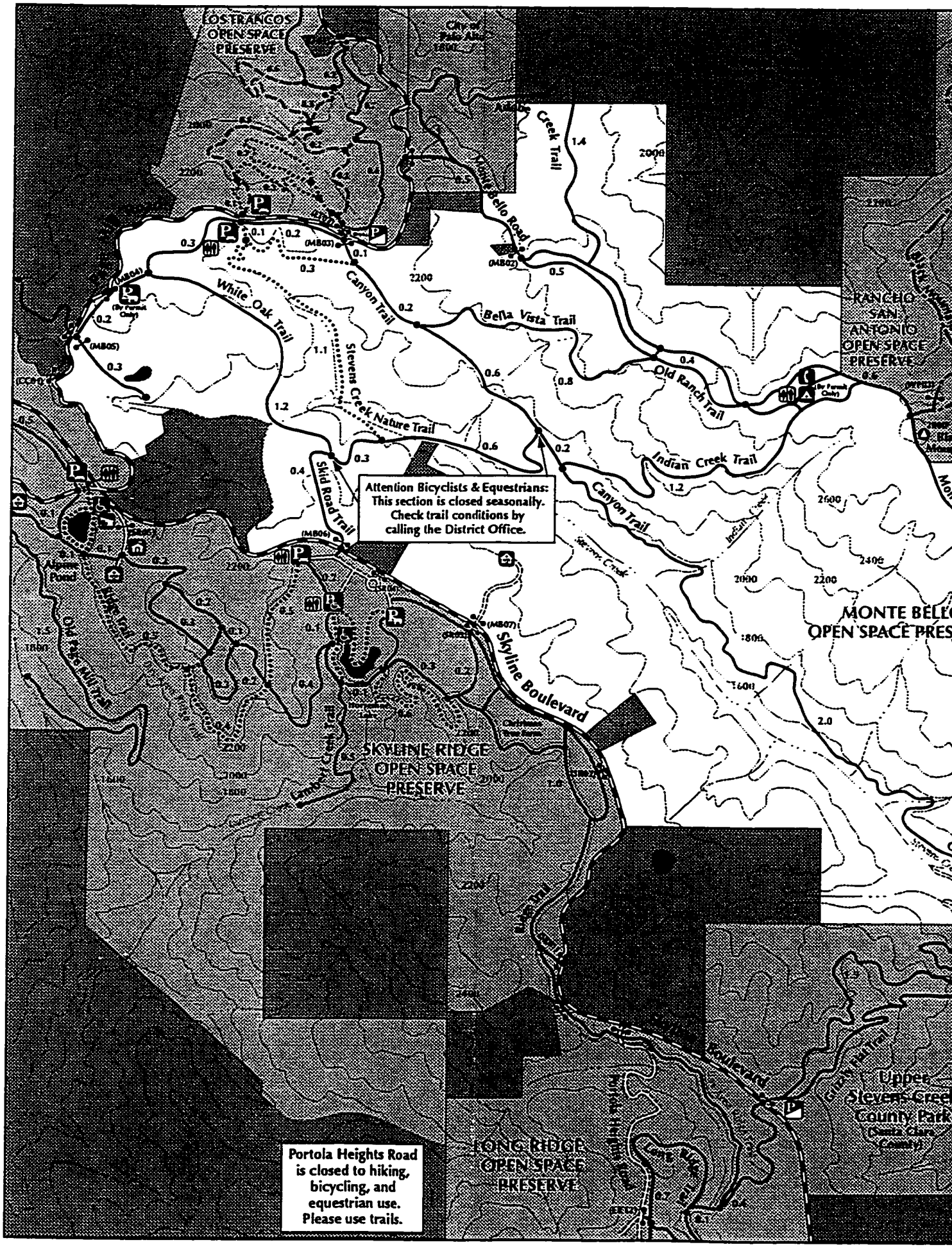
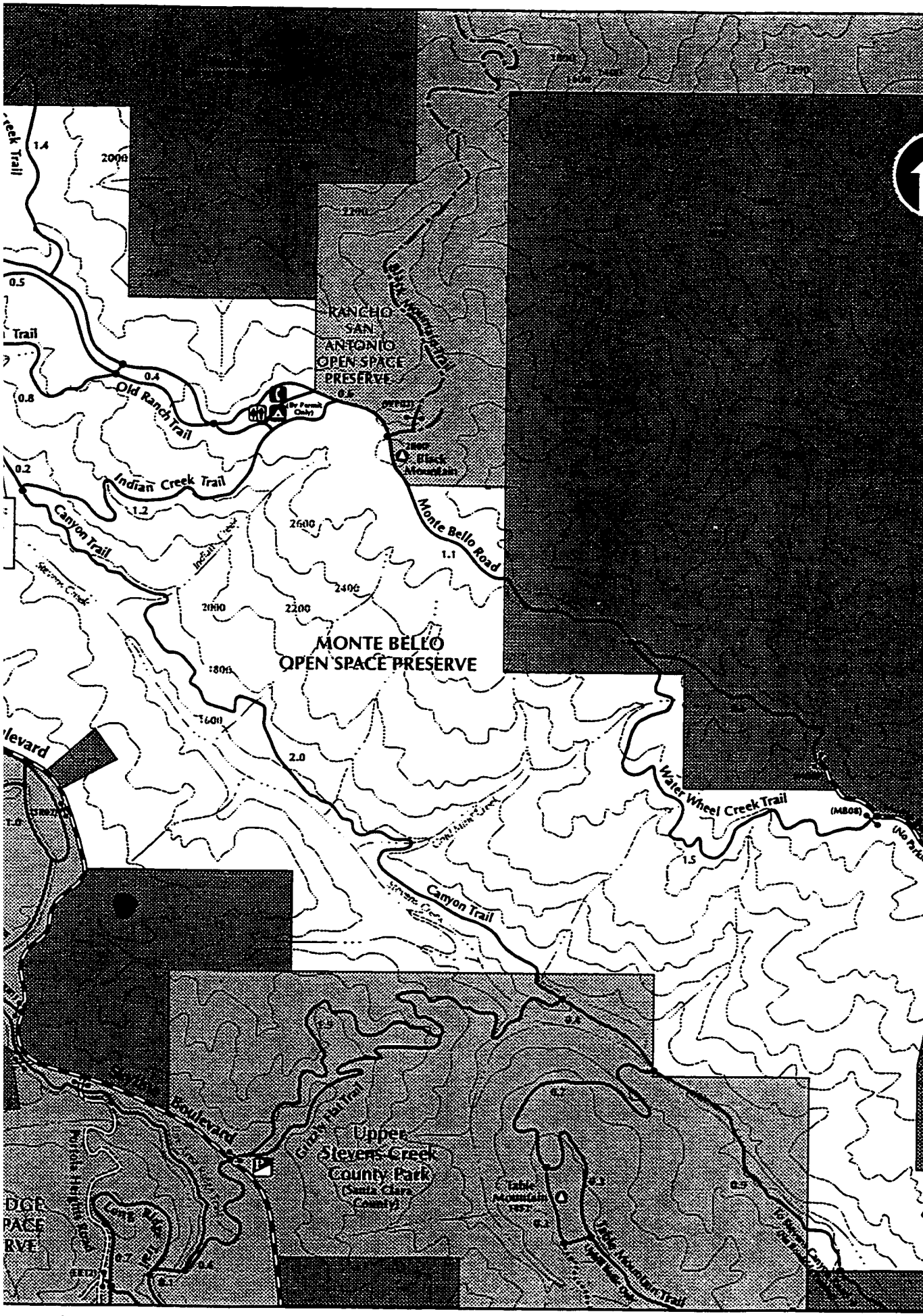
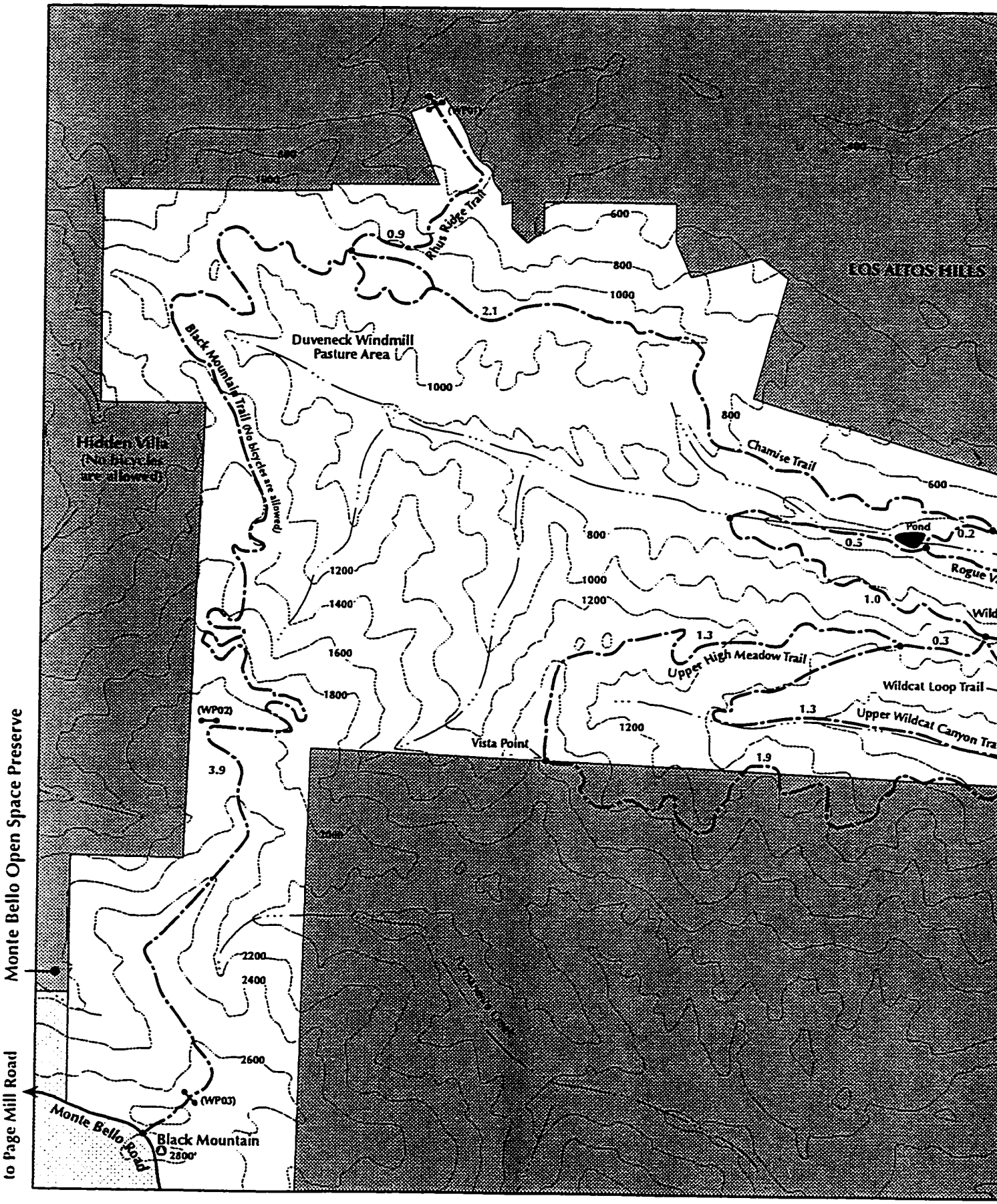


Fig. 10. Monte Bello Open Space Preserve map. Source: Midpeninsula Regional



ve map. Source: Midpeninsula Regional Open Space District. 1997.



RANCHO SAN ANTONIO

Open Space Preserve

Fig. 11. Rancho S

Source: Midpenin

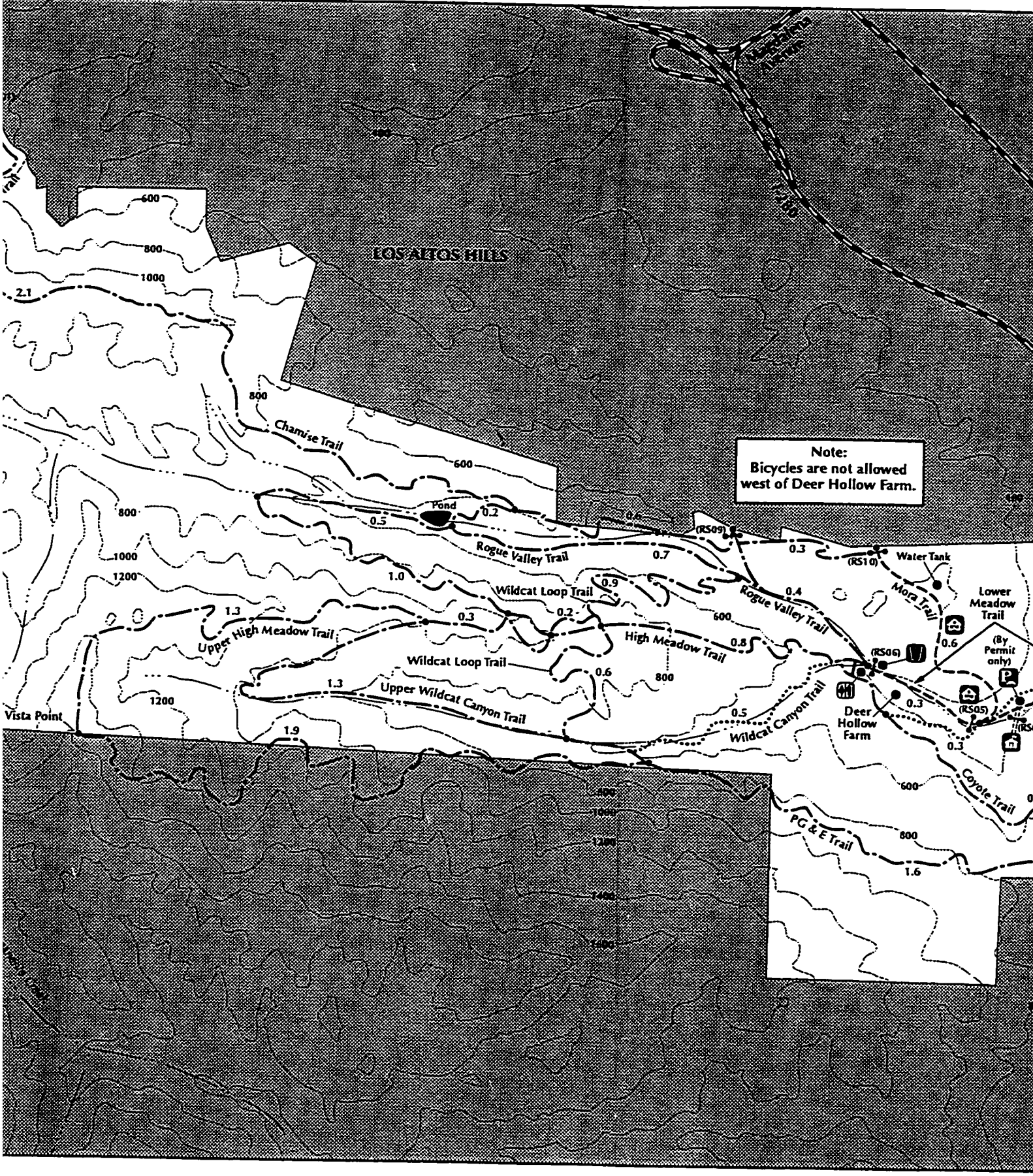


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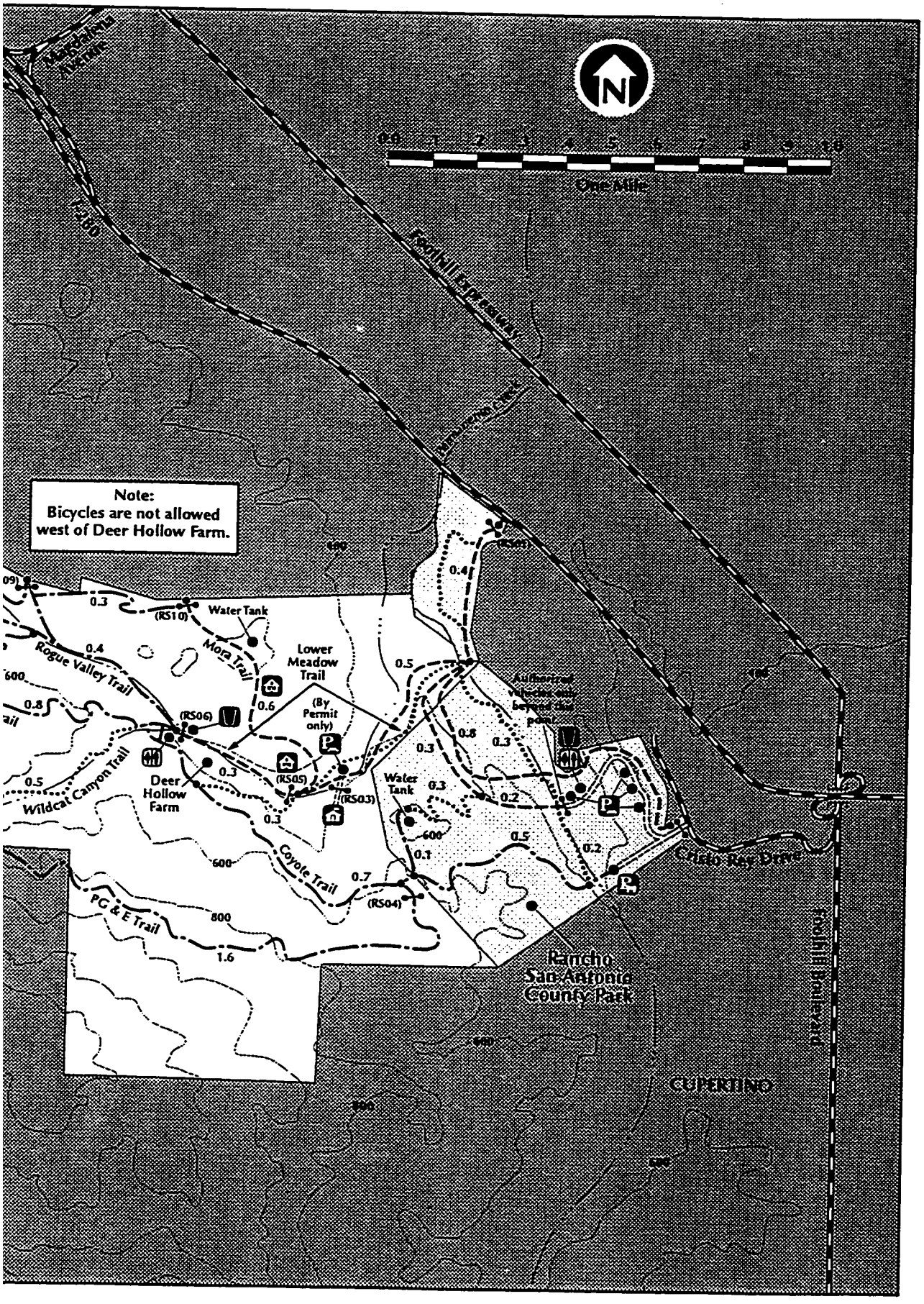
Fig. 11. Rancho San Antonio Open Space Preserve map.

MIDPENINSU

Source: Midpeninsula Regional Open Space District. 1997.



Trail Use

- Hiking Only
- Hiking, Equestrian
- Hiking, Bicycling
- Hiking, Bicycling, Equestrian

Note:
Dogs are not allowed on this preserve

Map Legend

- Gate (#s)
- 1.0 Trail Distance in Miles
- Vehicle Driveway
- Creek
- Parking Lot
- Equestrian Parking
- Residence
- Ranger Facility
- Restrooms
- Drinking Water
- Point of Interest
- Other Public Lands
- No Public Entry
  Private or Leased Lands

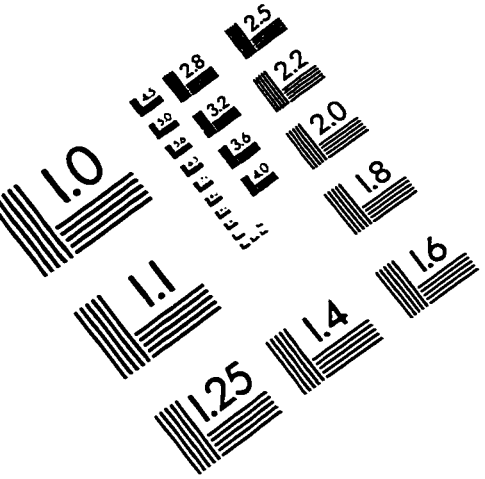
1/3/97

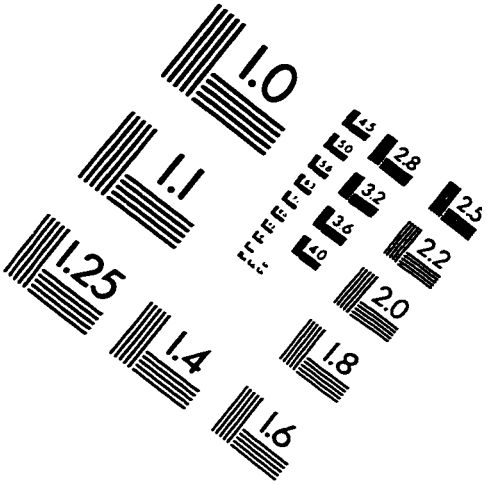
ice Preserve map.

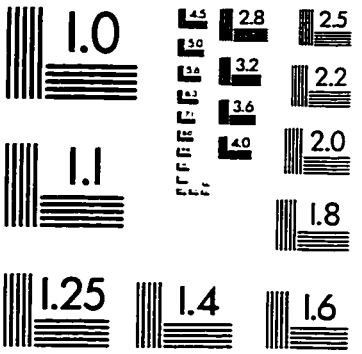
MIDPENINSULA REGIONAL OPEN SPACE DISTRICT

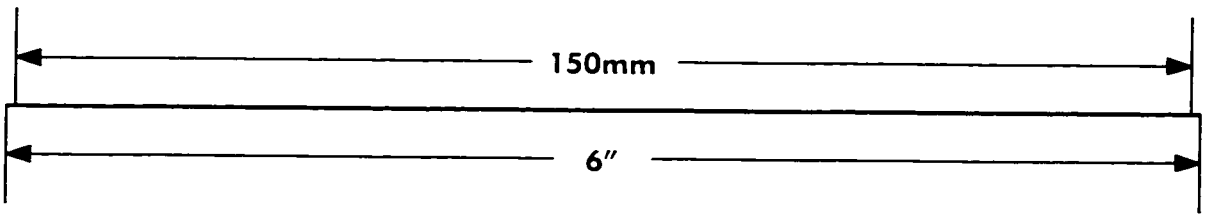
pace District. 1997.

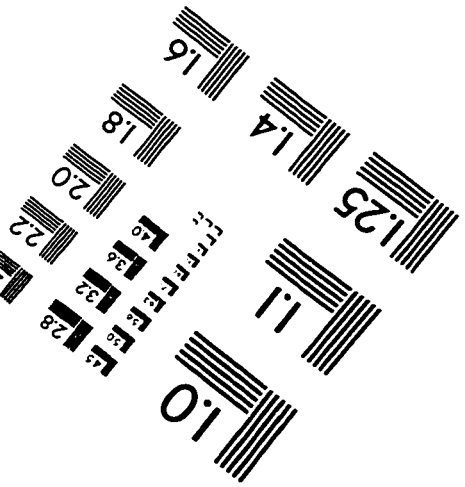
IMAGE EVALUATION TEST TARGET (QA-3)

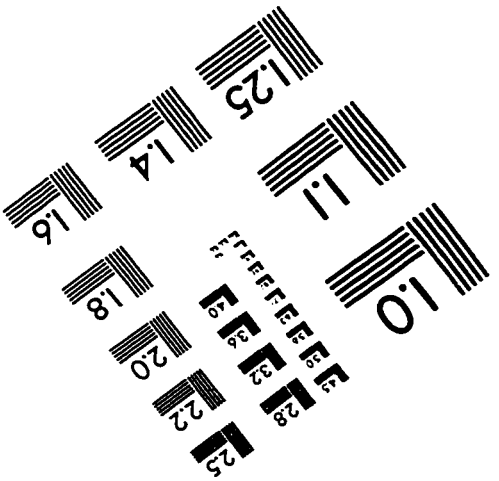












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